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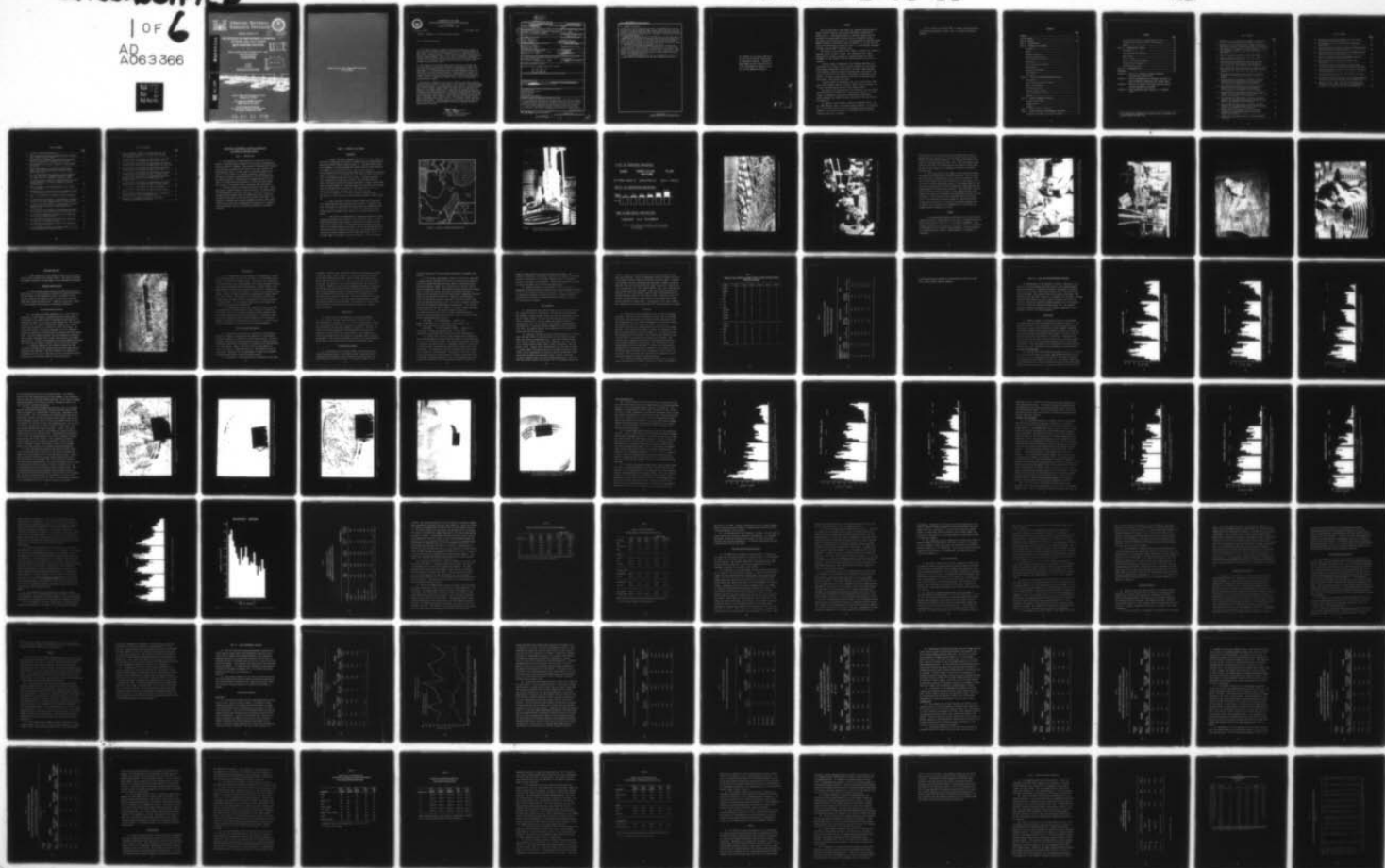
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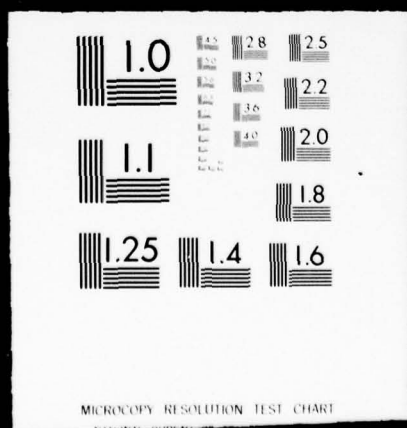
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# DREDGED MATERIAL RESEARCH PROGRAM



TECHNICAL REPORT D-78-38

## THE EFFECTS OF SMOTHERING A SPARTINA ALTERNIFLORA SALT MARSH WITH DREDGED MATERIAL

by

Robert J. Reimold, Michael A. Hardisky, Patrick C. Adams  
Marine Extension Service  
University of Georgia  
Brunswick, Ga. 31520

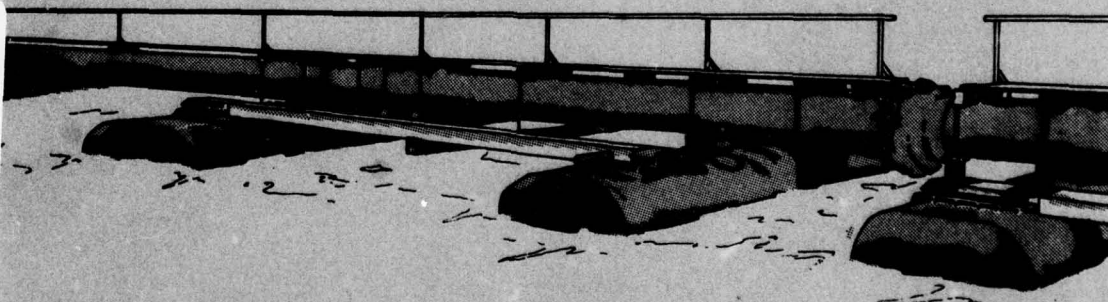
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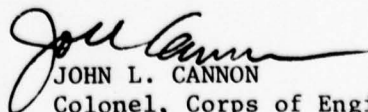
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1. The technical report transmitted herewith represents the results of Work Unit 2A07 regarding experimental deposition of dredged material on salt marsh. This work unit was conducted as part of Task 2A (Effects of Marsh and Terrestrial Disposal) of the Corps of Engineers' Dredged Material Research Program (DMRP). Task 2A was a part of the Habitat Development Project (HDP) of the DMRP and was concerned with the definition and quantification of the effects of dredged material disposal on shallow water, wetland, and terrestrial sites.
2. The purpose of this research (Work Unit 2A07) was to evaluate the recovery response of salt marsh vegetation to deposition of sand, sandy clay, and clay dredged material at various depths between 8 and 91 cm. The results of this study indicate that it may be possible to alter the elevations of a marsh through disposal of dredged material without loss of the functional values of that system. This research is largely conceptual in nature and has not been extensively field tested; application of this study to a large-scale disposal project should be approached with particular caution.
3. The specific findings of this study are distinct from other research conducted within the HDP, and the concept of the recovery of marsh smothered with dredged material is not addressed in other studies. Generally related work units are 4A04A1, 4A04A2, 4A04B, and 4A05, each of which deal with aspects of salt marsh productivity. Supportive and comparative data are available in Synthesis Report DS-78-15 entitled "Upland and Wetland Habitat Development with Dredged Material: Ecological Considerations" (2A08), and in the analysis of the results of field studies at Windmill Point, Virginia (4A11); Buttermilk Sound, Georgia (4A12); Apalachicola, Florida (4A19); Bolivar Peninsula, Texas (4A13); Pond No. 3, California (4A18); and Miller Sands, Oregon (4B05). Together these research products will provide the Corps with a basis for sound management decisions regarding disposal in marsh-estuarine systems.

  
JOHN L. CANNON

Colonel, Corps of Engineers  
Commander and Director

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) A study of the capability of high salt marsh to recover from disposal of dredged material indicates that smothering high marsh could be a feasible disposal alternative but should be used with caution and should only be employed when other alternatives are economically or physically infeasible. The study investigated the impact of smothering short form <i>Spartina alterniflora</i> in Glynn County, Georgia, with three types of dredged material (Continued)		

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20. ABSTRACT (Continued).

(coarse sand, sand and clay mixed, and clay), at six depths (8, 15, 23, 30, 61, and 91 cm), and at different stages of plant growth (February, July, and November). Corrugated metal pipes (0.9-m diam) were sunk into the marsh and used as containers for dredged material. The impact of disposal was evaluated over two growing seasons.

*Spartina alterniflora* was able to penetrate up to 23 cm of each type of dredged material and exhibited biological growth and production nearly equal to that in undisturbed marsh. These depths, being within the elevational range of the marsh, indicate that accurate tidal and elevational data should be collected before disposal on a marsh and that deposition should not exceed the elevational limit of the existing marsh. ~~assessed~~

The study also included an assessment of the impact of smothering on selected species of crabs and snails. Crabs were able to recolonize areas covered with up to 23 cm of clay dredged material and 15 cm of sand. Snails rapidly recolonized material placed 8 and 15 cm deep. Faunal recovery may depend on the proximity of the disposal area to natural populations and the extent of the smothered areas. ~~assessed~~

While smothering operations can offer an alternative to disposal, the technique cannot be considered proven and must be approached with care.

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## PREFACE

The work described in this report was conducted under Contract No. DACW21-75-C-0074 entitled, "Buttermilk Sound Habitat Development," between the U. S. Army Engineer District, Savannah, Georgia, and the University of Georgia Marine Extension Service, Brunswick, Georgia. The research was conducted as part of the Dredged Material Research Program (DMRP) sponsored by the Office, Chief of Engineers, U. S. Army, and monitored by the Environmental Laboratory (EL), U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss.

The authors of the report were Dr. Robert J. Reimold, Mr. Michael A. Hardisky, and Mr. Patrick C. Adams. Mrs. Kathy Smith, Mr. James Kowalchuck, Ms. Christine Langner, Mr. Stephen Pittman, Ms. Susan Gallagher, Mr. Ray Chauncey, and Mrs. Brenda Tillman assisted with the research.

A sincere thanks is expressed to the following individuals who contributed their efforts to the successful completion of the project: Dianne Adams, Roland Baker, Nancy Bevan, Lori Cobb, Joseph Hardisky, Jo Ann Hardisky, Barbara Harrington, William Harris, Bill Herrin, Pete Johnson, Tim Leftwich, Tom Lindsey, Grady McNure, Carnel Mosely, Tony Moseley, Joey Payne, Thomas Pearson, Brenda Sailors, Milledge Smith, James Vernon, and Professor Paul Wolf.

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COL G. H. Hilt, CE, and COL John L. Cannon, CE, were Directors of WES during the period of study. Mr. F. R. Brown was Technical Director.



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THE EFFECTS OF SMOTHERING A SPARTINA ALTERNIFLORA  
SALT MARSH WITH DREDGED MATERIAL

PART I: INTRODUCTION

1. The spreading of dredged material in a thin layer on the surface of existing coastal wetlands is a potentially environmentally compatible method of disposal. This method of dredged material disposal would provide an alternative that could be both cost effective and environmentally sound. In some areas, no acceptable disposal site exists in close proximity to dredging operations, therefore it is necessary to transport dredged materials to a distant disposal area. The time and expense of transporting the dredged material could be saved if a nearby marsh was smothered to a depth that would permit full recovery of the marsh within a relatively short time period.

2. Coastal areas are increasingly utilized by the public, thus generating a renewed interest in their protection. As public pressure for environmentally sound and economically feasible alternatives to dredged material disposal grow, the manager must have a variety of documented alternatives so that the best decision can be made. The aesthetic, ecological and economic standards set forth by the coastal citizens can only be met by possessing the technology for a number of sound alternatives such as the controlled smothering of existing wetlands.

## PART II: MATERIALS AND METHODS

### Treatments

3. A high, intertidal, homogenous *Spartina alterniflora* marsh was selected to investigate the effects of various layers of dredged material placed on existing coastal wetlands (Figure 1). Corrugated metal pipes, 0.9 m diameter, of various lengths were inserted into the marsh substrate to a depth of 1.2 m in February 1976. The 1.2 below the marsh surface ensured that only the enclosed marsh plants, animals, and substrate would be influenced by the dredged material. The pipes were placed such that a 1-m walkway was available on all sides. A dragline equipped with a modified pile driver was utilized to push the pipes into the marsh. Each pipe was measured during installation to insure proper height above the marsh (Figure 2). The metal pipes were placed in such a fashion that they extended above the surface of the marsh 8 cm (3 in.), 15 cm (6 in.), 23 cm (9 in.), 30 cm (12 in.), 61 cm (24 in.) and 91 cm (36 in.) (Figure 3). The various container heights provided the effect of a dike for each of the six different height classes (Figure 4).

4. Three replicates of each enclosure height were filled with each dredged material type in February and July 1976. In November 1976 only 2 replicates of each height were filled with each dredged material type. The purpose of this was to investigate the seasonal effects of dredged material disposal on the surface of an already existant salt marsh.

5. Three types of dredged material frequently encountered during dredging operations in the southeast were selected for study. A coarse sand from Buttermilk Sound, Georgia, a sand and clay mixture from the Darien River, Georgia and a clay from Jekyll Creek, Georgia, were most typical of dredged sediments of the area. Each of the dredged materials was collected from an existing disposal site. The dredged material was collected in buckets, dumped into 208-l drums and hoisted onto the R/V Capt. Gene for transport to the dock (Figure 5). The clay dredged



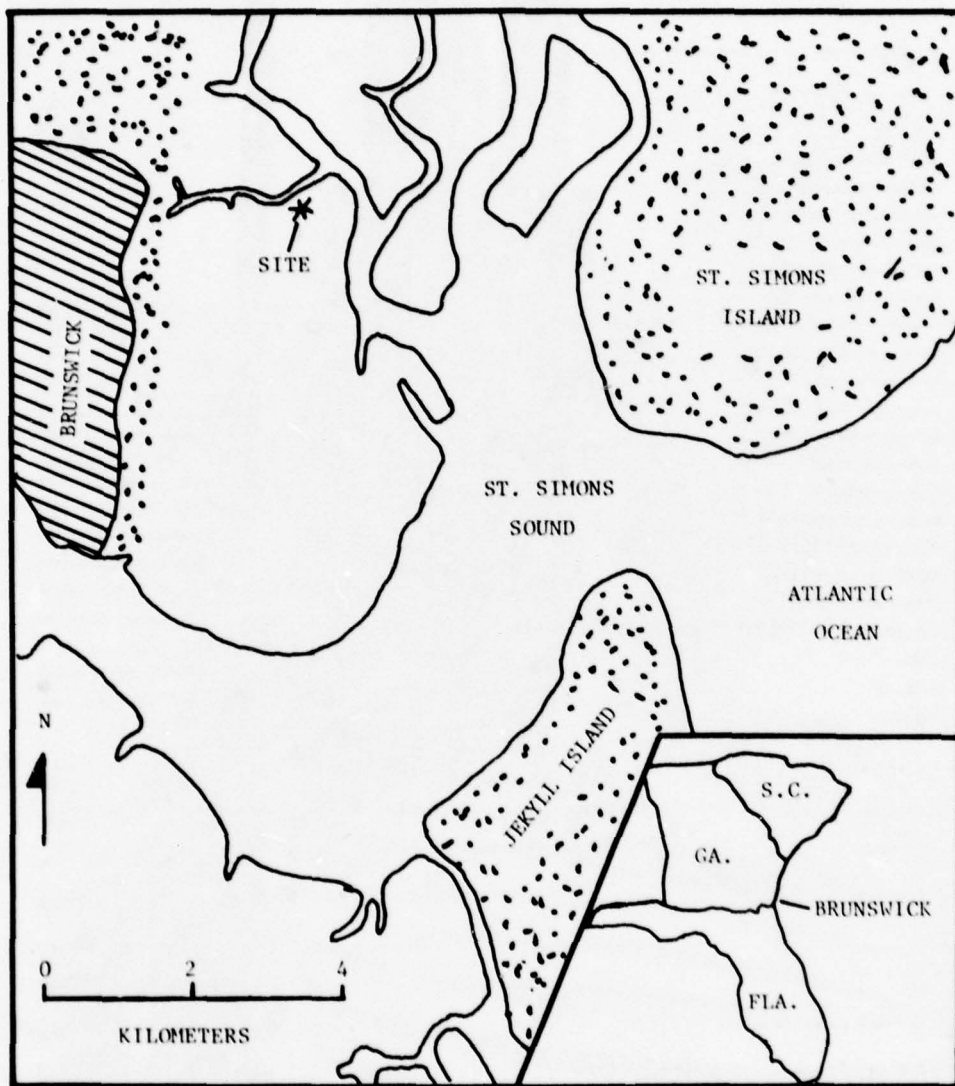


Figure 1. Location of Marsh Smothering Site.

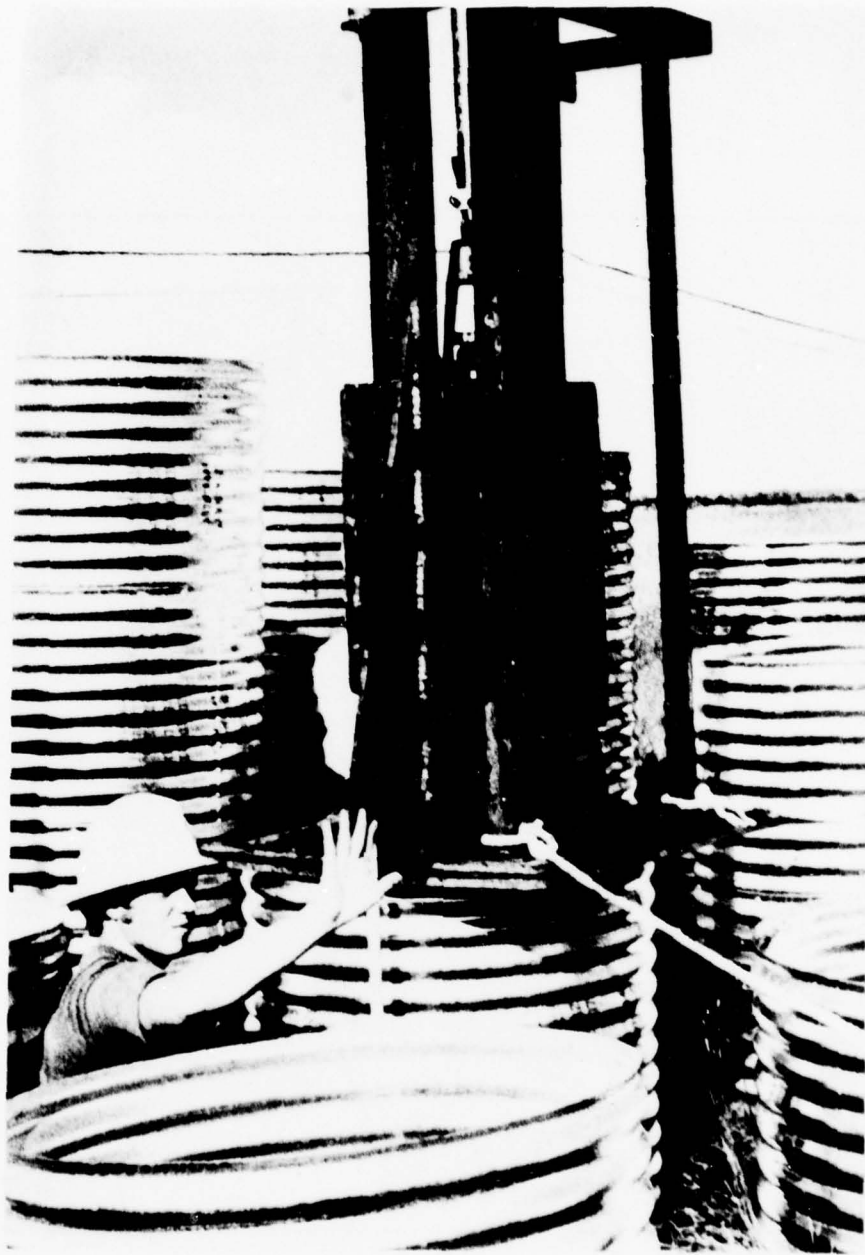


Figure 2. Each enclosure was measured during insertion to ensure proper height above the marsh.

TYPE OF DREDGED MATERIAL

SAND

SAND / CLAY  
MIXTURE

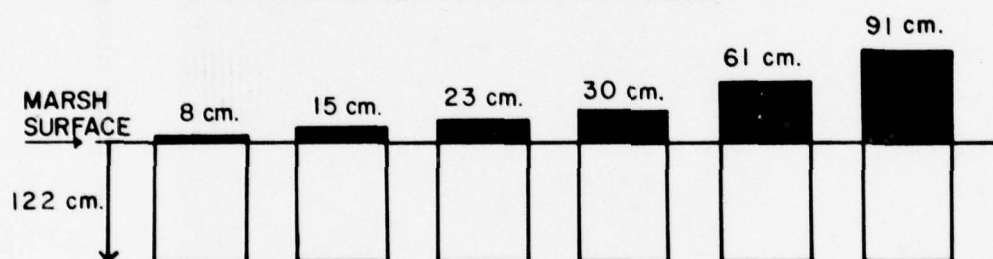
CLAY

BUTTERMILK SOUND, GA.

DARIEN RIVER, GA.

JEKYLL CREEK, GA.

DEPTH OF DEPOSITED MATERIAL



TIME OF MATERIAL DEPOSITION

FEBRUARY JULY NOVEMBER

Figure 3. Description of treatments and illustration of experimental enclosures after placement in the marsh.

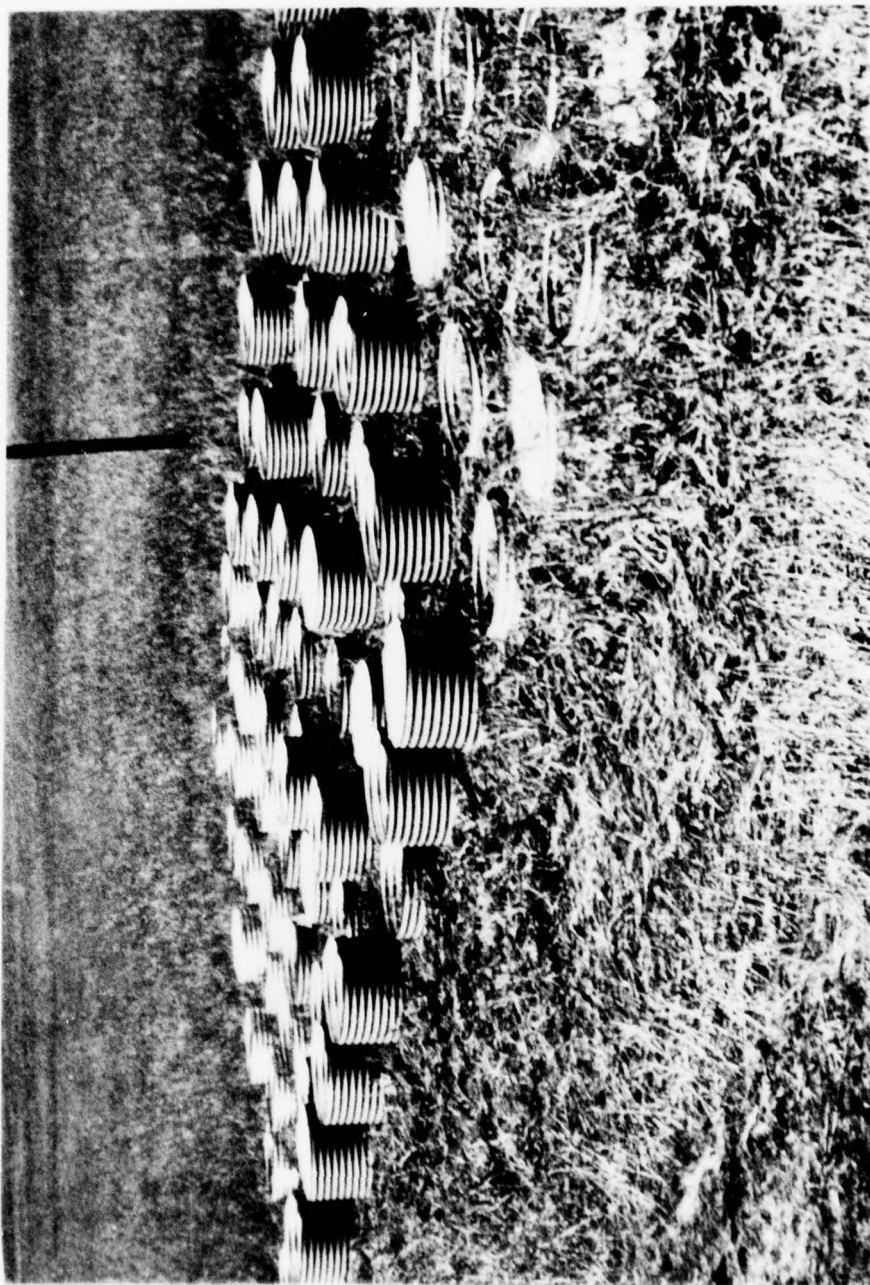


Figure 4. Marsh Smothering site after placement of experimental enclosures.





Figure 5. Sand dredged material was collected with buckets, dumped into drums and shuttled to research vessel with a small boat.

material disposal site was inundated by daily high tides, thus the material had been maintained in a moist, anaerobic state after being dredged from the waterway (Figure 6). The sand and the sand and clay sites were maintained above mean high water. When the research vessel arrived at the dock, the dredged material was hoisted from the vessel and onto a truck (Figure 7) for subsequent transport to the marsh smothering site.

6. The dredged material was dipped from the drums with buckets and dumped into the appropriate enclosure (Figure 8). All enclosures were filled with dredged material to the top of the enclosure. The 8 and 15 cm enclosures after being filled had most of the taller *Spartina alterniflora* culms protruding the surface of the dredged material. The only culms protruding the 23 and 30 cm depths were culms which had been pressed against the sides of the enclosures. This edge effect occurred to varying degrees and was the result of the dredged material being dumped at the center of the enclosure and subsequently folding the culms to the side. The 61 and 91 cm fills completely buried the *Spartina alterniflora* inside the enclosures (Figure 9). During the November filling, many of the *Spartina alterniflora* culms had seedheads, thus in several cases a portion of the seedhead was left protruding the dredged material through 61 cm of fill.

#### Design

7. The experimental design was established as a 3-way factorial design utilizing six filling depths, three types of dredged material and three filling dates to give a 6 x 3 x 3 factorial arrangement. Each treatment combination was replicated three times, except for the November filling where only two replicates were available. All the enclosures were randomized using a table of random numbers for assignment of treatments.



Figure 6. The clay dredged material disposed site was inundated by daily high tides. Dredged material was loaded on a small boat for transport to research vessel.

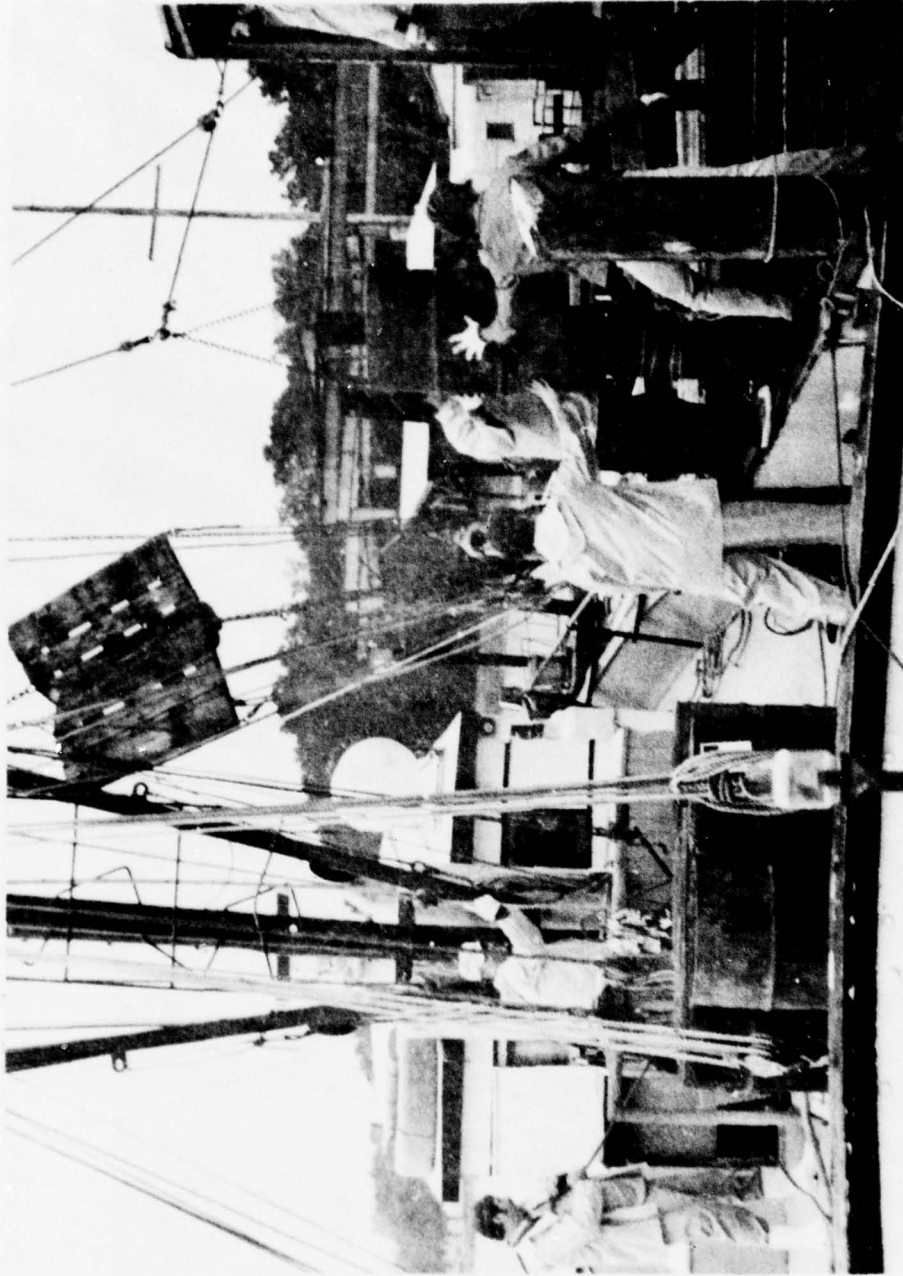


Figure 7. Off loading drums filled with dredged material from the research vessel to a truck for transport to Marsh Smothering site.





Figure 8. Manual dumping of clay dredged material into a 23 cm enclosure.

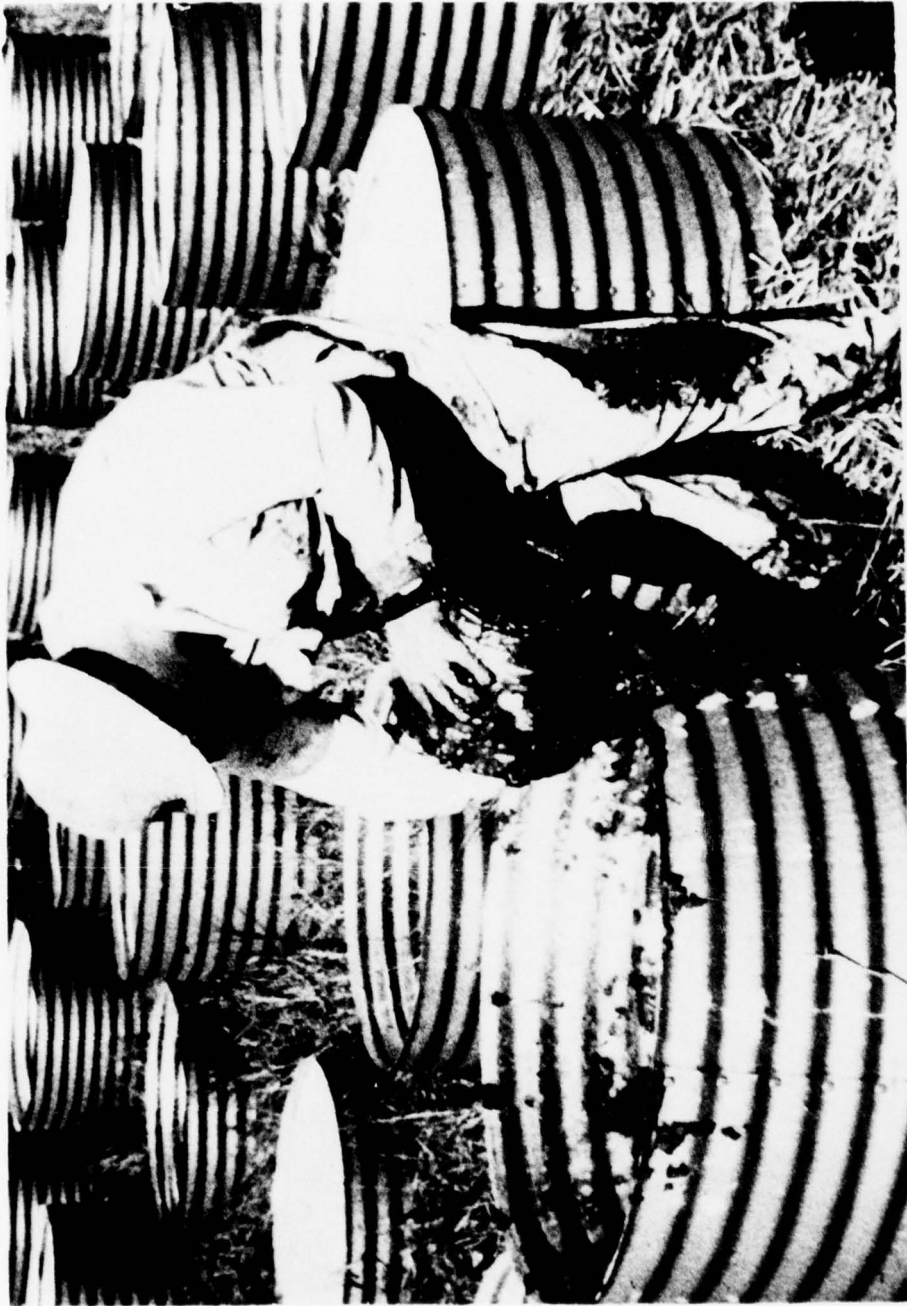


Figure 9. Smothering a 61 cm enclosure with clay dredged material. No culms exceeded the top of the enclosure.

#### Enclosure Controls

8. Three replicates of each height enclosure were set aside as control areas to monitor any container effect. The control enclosures were sampled monthly in the same manner as the experimental enclosures.

#### Adjacent Marsh Controls

9. Five randomly selected areas in the *Spartina alterniflora* marsh adjacent to the experimental enclosures were monitored monthly in the same manner as the experimental areas. An  $0.656 \text{ m}^2$  circular ring was placed on the marsh for culm, live crab, crab burrow and marsh snails density determinations. These areas served as a control to normal seasonal fluctuations in the measured populations.

#### 3m X 3m Enclosure Controls

10. Two square enclosures measuring 3 m on a side ( $9 \text{ m}^2$ ) were constructed to test changes in measured populations which might be attributable to the smaller  $0.656 \text{ m}^2$  experimental enclosures and to ascertain the affect of a larger enclosure (Figure 10). The enclosure consisted of 1.5 m lengths of galvanized corrugated steel roofing driven into the marsh 1.2 m, leaving 30 cm above the surface. Although each section of steel was overlapped 5 to 10 cm, some gaps remained allowing entry to tidal waters and possibly very small fiddler crabs. This was slightly different from the experimental enclosures which allowed tidal water entry at small drain holes at the dredged material level. Fiddler crab movements from the experimental enclosures were restricted to escape or entrance over the top of the enclosure.

11. Monthly sampling of the enclosures entailed the same techniques described for the adjacent marsh controls except only two replicates were performed. Care was exercised in the gathering of information from the 3m x 3m enclosure in order that minimal damage be inflicted upon the resident plant and animal populations.

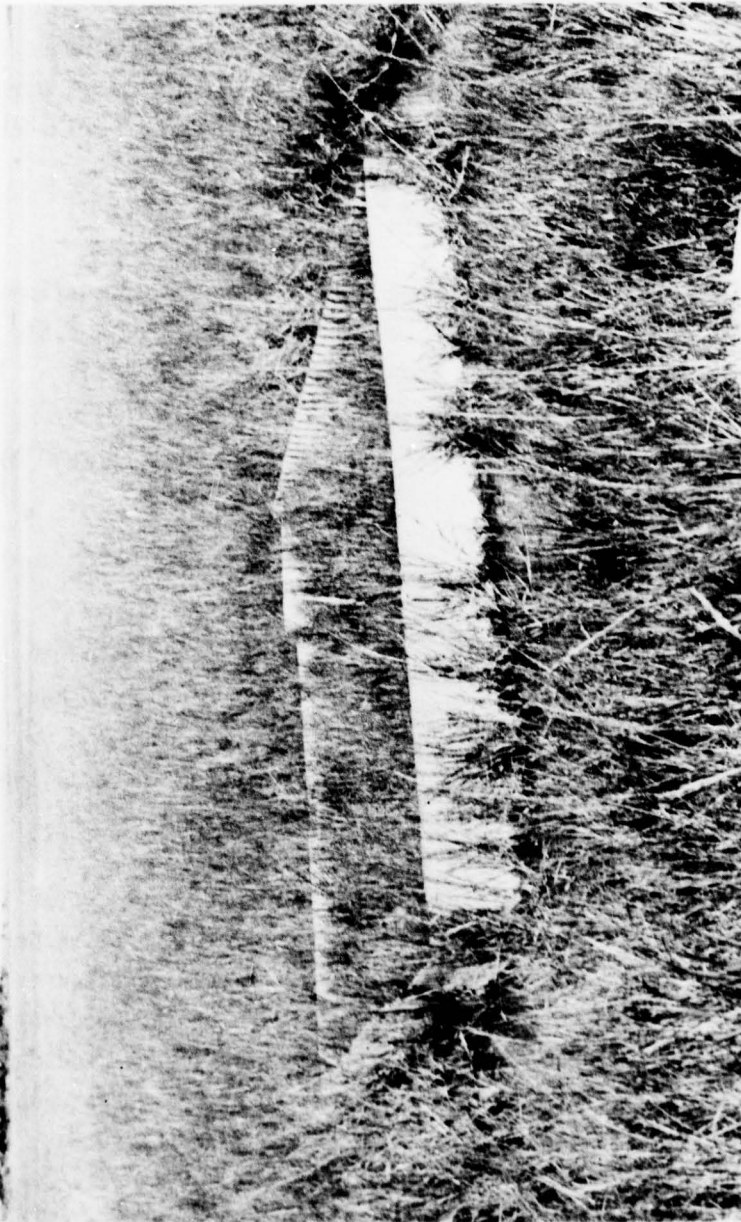


Figure 10. 3m x 3m enclosure area adjacent to Marsh Smothering site.



### Culm Density

12. The measurement of culm density was accomplished by counting all live shoots within each  $0.656 \text{ m}^2$  enclosure. Any culm having green or purple coloration was considered living. Counting all live culms within an enclosure reduced the random sampling error between successive intervals associated with subsample quadrat measurements. Monthly density counts began immediately after each of the three fillings so as to measure the initial status of each filled enclosure. In many of the shallower filling depths, a number of stems protruded the dredged material surface immediately after filling. Documentation of culm densities surviving the filling operation helped to better estimate the true recovery potential of each enclosure. All culm density counts used in the analysis were converted and expressed as the number/ $\text{m}^2$ .

13. The treatments tested in the analysis of variance were depth of dredged material, dredged material type, and month of deposition. Culm density was the only regularly monitored response parameter which was a direct measurement of the plant population. Culm density served as the most consistent measure of plant response for all treatments. Normal fluctuations in culm densities of the *Spartina alterniflora* population were monitored via control areas in surrounding marshes.

### Live Crabs and Crab Burrows

14. Considering the recovery of a marsh from a perturbation as physically damaging as dredged material deposition, it was necessary to assume cessation of a majority of normal marsh functions. From this viewpoint, monitoring of plant populations as well as associated macro-invertebrate populations was essential in documenting the reestablishment of a viable marsh. Fiddler crabs were found in large numbers in a *Spartina alterniflora* highmarsh (Wolf et al. 1975) similar to the one under study. Therefore, the reestablishment of fiddler and squareback crab populations should accompany the marsh recovery.

15. Estimation of crab populations was accomplished in two ways:

1) density of observed live crabs and 2) density of crab burrows contained in each enclosure. Before filling, *Uca pugnax* was the major inhabitant of the marsh inside the enclosures. After filling, the change in substrate type attracted *Uca pugilator* and *Sesarma reticulatum* to the filled enclosures. The density of live crabs represented the total observed of all species. Density of live crabs was dependent upon weather conditions and the time spent by each field team in estimating the relative number. Since live crab density was such a variable measure, its model was used only to substantiate the existence and species of crab populations described by the crab burrow densities. Crab burrow densities represented crab activity, however, no actual correlation between population numbers and burrows present was ever performed. The comparison of adjacent marsh burrow densities and enclosure burrow densities served as a relative index of recovery.

#### Marsh Snails

16. Along with the crab populations, the marsh periwinkle (*Littorina irrorata*) and the coffee bean snail (*Melampus bidentatus*) were inhabitants of adjacent *Spartina alterniflora* high marshes. Unlike the crab populations, the snail populations are dependent upon the salt marsh vegetation and associated epiphytes for survival. Therefore, the return of the snail populations in the experimental enclosures was expected to be slower than the crab populations. The two species of snails were counted within each enclosure to determine density expressed as snails/m<sup>2</sup>. Care was exercised while counting not to include abandoned shells lying on the dredged material surface in the density count.

#### Standing Crop Biomass

17. Culm density was a parameter having some variation and not always being proportional to the biomass present. There was need of a technique by which biomass could be estimated without destroying the plants within the 0.656 m<sup>2</sup> enclosures. By deriving biomass, a more

equitable comparison of success between experimental treatments could be made.

18. The linear relationship of *Spartina alterniflora* culm height to biomass (linear regression) for *Spartina alterniflora* was tested in Connecticut marshes by Nixon and Oviatt (1973), in North Carolina by Williams and Murdock (1969), and in Florida and on the Gulf coast by Turner and Gosselink (1975). All studies described significant relationships of height with biomass and Turner and Gosselink pointed out changes in the regression coefficient with latitude, suggesting localized equations would provide the best fit. Therefore, in developing a predictive regression equation, culms were collected at several times during the growing season from *Spartina alterniflora* marshes surrounding the study area (Reimold and Hardisky, in preparation). Each culm was measured (height in cm) dried at 100°C to a constant weight and weighed to the nearest 0.001 g. The grams dry weight biomass and the height (cm) were used to derive a linear regression equation. Predictive regression equations derived for *Spartina alterniflora* high-marsh at Marsh Smothering site were:

$$\text{LIVE CULMS} \quad \hat{y} = 0.076 * (\text{Height}) \quad \text{Equation (1)}$$

Height is expressed in cm,  $r^2$  equaled 0.86 significant at the 0.0001 level, and there were 600 observations.

$$\text{DEAD CULMS} \quad \hat{y} = 0.054 * (\text{Height}) - (0.988) \quad \text{Equation (2)}$$

In Equation 2, Height is expressed in cm,  $r^2$  equaled 0.64 significant at the 0.0001 level, and there were 604 observations.

19. In April 1977 0.05 m<sup>2</sup> circular quadrats were positioned in each of the experimental enclosures and all control areas provided some *Spartina alterniflora* was present. Placement of the quadrats was random in enclosures containing substantial vegetation, however, in enclosures of limited recovery the quadrat was positioned to contain some of the living culms. The quadrats were staked and remained in each enclosure for the duration of the experiment. The height of each live or dead culm was measured from the soil surface to the tip of the tallest leaf or seedhead. Subsequent summation of live culm heights and dead culm heights and substitution into the appropriate equations yielded the

grams dry weight (gdw) live and dead standing crop biomass. The estimate of biomass for experimental enclosures was compared to enclosure controls (3 replicates of each height), adjacent marsh (5 replicates), and 3m x 3m enclosures (4 replicates). Biomass was estimated by the same procedure in November 1977 utilizing the same quadrats.

20. Biomass estimates of the adjacent *Spartina alterniflora* highmarsh utilizing destructive techniques were performed monthly utilizing 0.1 m<sup>2</sup> circular quadrats (Reimold and Linthurst, 1977). The determination of standing crop biomass by traditional harvest techniques compared to non-destructive estimates of biomass indicated the relative accuracy of the non-destructive methods.

#### Soil Chemistry

21. Soil samples were collected using a 4.4 cm (I.D.) section of PVC irrigation pipe as a coring device. The PVC pipe was pushed into the substrate, a rubber stopper placed over the top opening and the pipe and core sample removed. The soil was extracted from the pipe onto a sheet of aluminum foil. The core sample was wrapped, sealed and transported on ice to the laboratory. The substrate was homogenized and composited, if necessary, before subsamples for nutrient analysis were taken. All mineral analyses were conducted by the University of Georgia Soil Testing Laboratory.

22. Analyses of potassium, calcium and magnesium were according to Issac and Jones (1971) for determination on an Auto Analyzer System. Other trace mineral methodologies were: boron, Wolf (1971); sulphur, Jones and Issac (1972); extractable zinc, manganese, and iron, Nelson et al. (1953), Perkins (1970); copper, cobalt, and arsenic, Issac and Kerber, (1971). Organic matter determination were performed according to Jackson (1958), pH determinations were performed according to Peech (1965), and Eh determination according to Pearsall and Mortimer (1939). Extractable phosphorus was determined using an oxalate extraction procedure (Saunders 1965) with the following modification: shake sediment with oxalate solution (0.1M oxalic acid + 0.2M ammonium oxalate pH



3.25) in a solid to extractant ratio of 1:20 (oven dry basis) for two hours and centrifuge. Filter the supernatant solution through 0.45 micron filter paper and analyze (Khalid and Patrick, personal comm.). Analyses of extractable and total phosphorus were performed according to Technicon (#94-70W, 1973) and Technicon (#376-75W, 1975) respectively. Nitrate and nitrite (Armstrong et al. 1967) ammonia (FWPCA, 1969), total dissolved and total nitrogen (Van Slyke and Hiller 1933), were analyzed using an Auto Analyzer II. The cation exchange capacity (CEC) was determined using a slightly modified version of Toth and Ott (1970). Isopropyl alcohol (99 percent) was substituted for ethyl alcohol in the washing step for the reasons outlined in Chapman (1965). Determination of the index, ammonia, was accomplished as previously described using the Auto Analyzer II system.

#### Elevation

23. Tidal data for the experimental area was from a tide gauge stationed at the State Docks in Brunswick, Georgia, some 4 km from the study area. The elevation of each enclosure before and after filling was determined from a U.S. Geodetic Benchmark at the Back River bridge, approximately 0.5 from the experimental area. The elevation was taken as the mean of 3 random points on the surface of the dredged material. Daily tidal data was used to estimate the frequency of inundation of the experimental enclosures (Table 1). Enclosure elevations were determined to be the height of the consolidation, therefore, many of the 61 and 91 cm enclosures were theoretically inundated. The enclosure walls contained drain holes at the dredged material surface which allowed inundation of these areas. The consolidation of each dredged material after 10 days (Table 2) indicated the high degree of shrinkage of the dredged material as compared to the enclosure walls. This consolidation accounted for the inundations of the 61 and 91 cm enclosures. The small drain holes restricted the inundation of tidal waters and limited the degree of actual inundation.

24. All data was punched on IBM punch cards and stored on magnetic tape at the University of Georgia. Statistical analyses and graphical

TABLE 1

FREQUENCY OF TIDAL INUNDATION IN NUMBER OF EVENTS PER MONTH FOR MARSH SMOTHERING  
EXPERIMENTAL ENCLOSURES

	DATE	8 cm.	15 cm.	23 cm.	30 cm.	61 cm.	91 cm.
	JANUARY	19	16	8	6	0	0
	FEBRUARY	14	12	11	9	0	0
	MARCH	19	18	12	10	0	0
	APRIL	26	22	17	14	3	0
1	MAY	32	29	22	21	5	0
9	JUNE	38	34	31	25	9	0
7	JULY	12	9	7	7	0	0
6	AUGUST	37	37	28	27	1	0
	SEPTEMBER	38	37	27	25	2	0
	OCTOBER	40	40	30	24	0	0
	NOVEMBER	26	23	17	15	2	0
	DECEMBER	7	6	5	3	0	0
<hr style="border-top: 1px dashed;"/>							
	JANUARY	20	16	10	8	0	0
	FEBRUARY	19	13	7	6	0	0
1	MARCH	29	25	20	15	0	0
9	APRIL	31	22	17	17	0	0
7	MAY	45	41	36	31	7	1
7	JUNE	40	34	33	31	8	3
	JULY	36	32	26	24	6	1
	NOVEMBER	49	45	35	33	6	2

TABLE 2

Average Vertical Consolidation of Dredged  
Material Ten Days After Placement  
in Marsh Smothering Enclosures

Dredged Material: Original Depth of Dredged Material in cm	<u>SAND</u>		<u>SAND AND CLAY</u>				<u>CLAY</u>	
	Average Vertical Shrinkage in cm	% Consolidation	Average Vertical Shrinkage in cm	% Consolidation	Average Vertical Shrinkage in cm	% Consolidation	Average Vertical Shrinkage in cm	% Consolidation
8	3.6	47.4	2.9	38.2	2.0	26.3		
15	4.2	27.6	1.6	10.5	4.1	27.0		
23	4.7	20.5	3.8	16.6	6.4	27.9		
30	5.2	17.0	4.3	14.1	7.1	23.3		
61	7.0	11.5	4.3	7.0	11.6	19.0		
91	6.1	6.7	3.8	4.2	13.6	14.9		

representations were according to the established procedures of Barr et al. (1976) using an IBM 370 computer.



### PART III: PLANT AND MACROINVERTEBRATE RESPONSE

25. Measurements of the dependent variables, culm density, live crab and crab burrow density and snail density, were conducted monthly within each enclosure. Densities included in the analysis of variance (GLM) were from December 1976 through November 1977. The three filling periods (February, July, November) had been completed by December, thus providing a more equitable comparison of treatments for the model. Problems associated with response time were evident throughout the statistical analysis. Significant differences among treatment means were expressed at the 0.05 level using Duncans' Multiple Range test. The complete analysis of variance and means for each treatment combination for all dependent variables are found in Appendix A.

#### Culm Density

26. Monthly changes in culm densities inside the experimental enclosures and control areas are depicted in Figures 11 through 21. The monthly culm densities for experimental enclosures represented in the figures were a mean of the 3 replicates of each treatment combination. The November smothering period was represented by means of 2 replicates. The control enclosure mean densities were means of 3 replicates and the adjacent marsh control were means of 5 replicates. Occasionally very large increases or decreases in culm density within a treatment combination was the result of an inexperienced sampler or error in recording culm density. The large breaks in the histograms were obvious and actual densities were best represented by the preceeding and following months.

#### February 1976 Smothering

27. The February filling showed no recovery of *Spartina alterniflora* in 61 and 91 cm enclosures for the two sandy dredged materials and only *Spartina alterniflora* seedlings in 61 and 91 cm enclosures filled with clay dredged material (Figures 11 through 13). Culm density immediately after filling for each enclosure height was greatest for the sand dredged material, next was the sand and clay material and about half the density

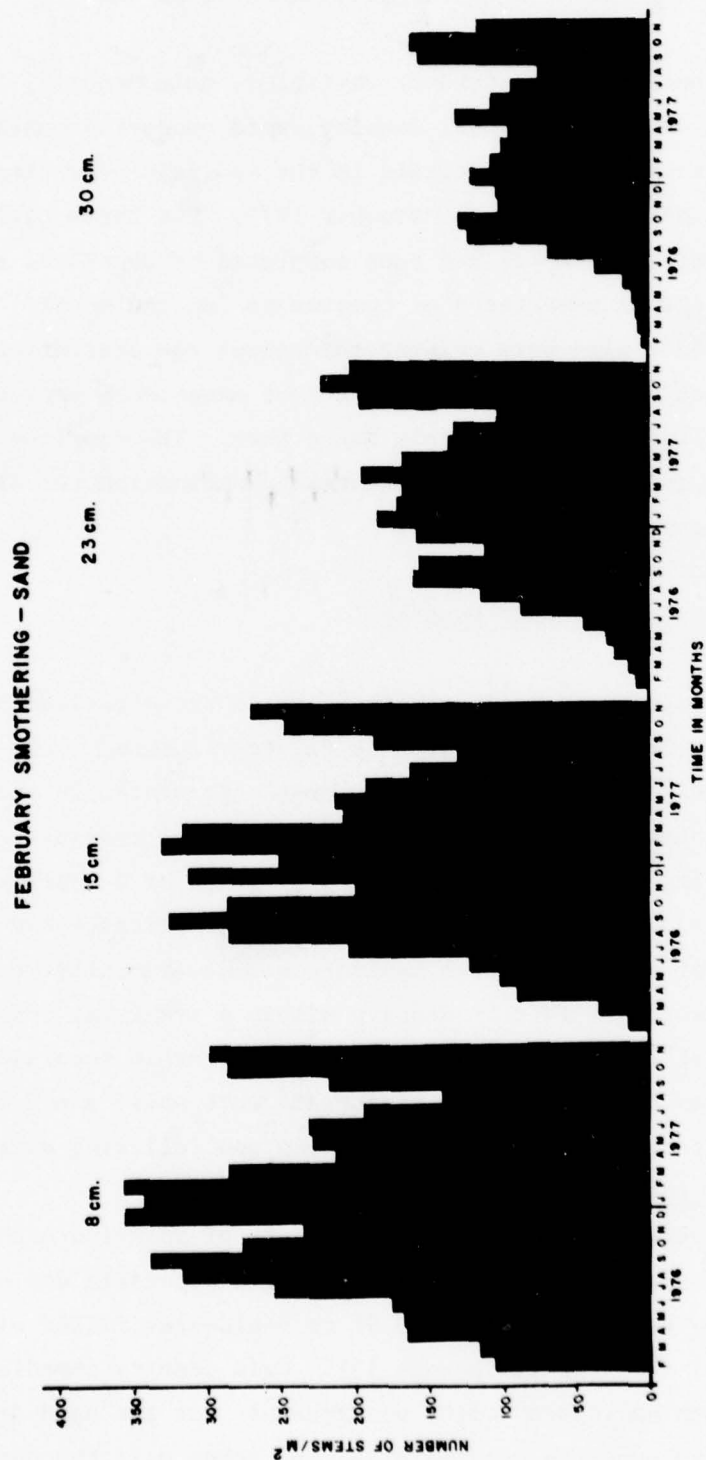


Figure 11. *S. alterniflora* culm density in experimental enclosures smothered with sand dredged material in February 1976.

# FEBRUARY SMOTHERING - SAND AND CLAY

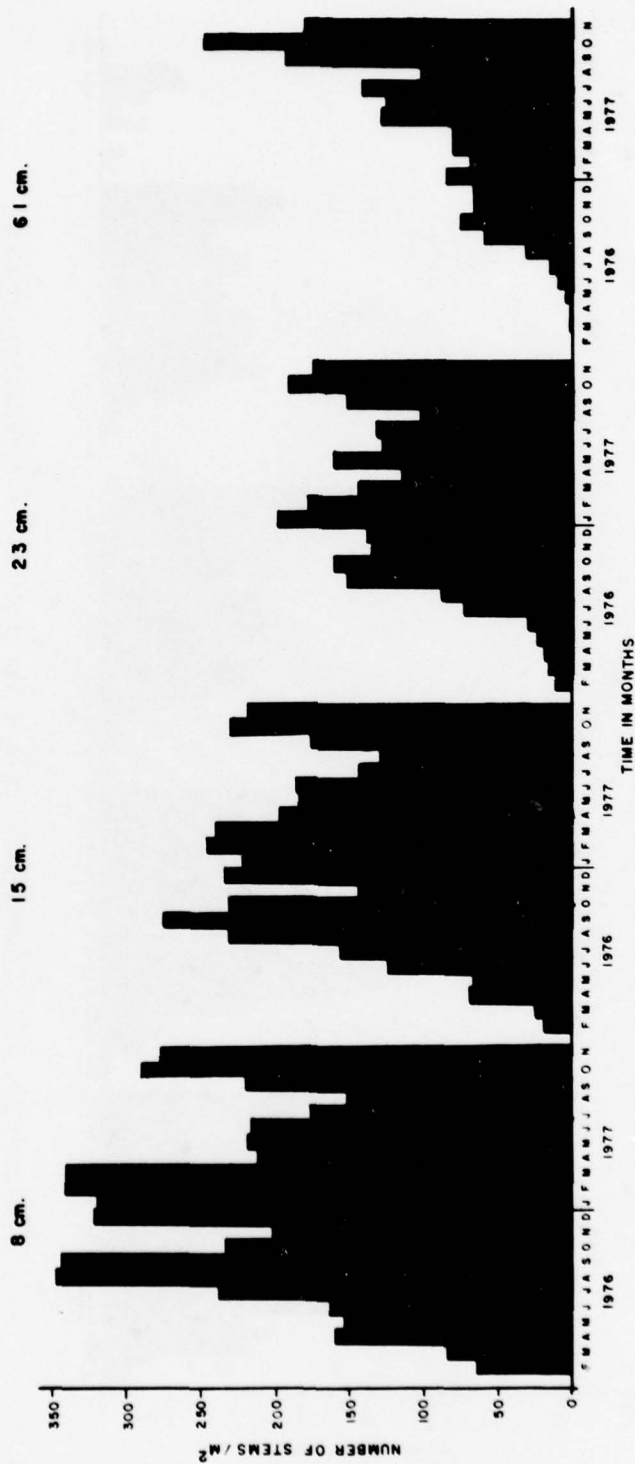


Figure 12. *S. alterniflora* culm density in experimental enclosures smothered with sand and clay dredged material in February 1976.

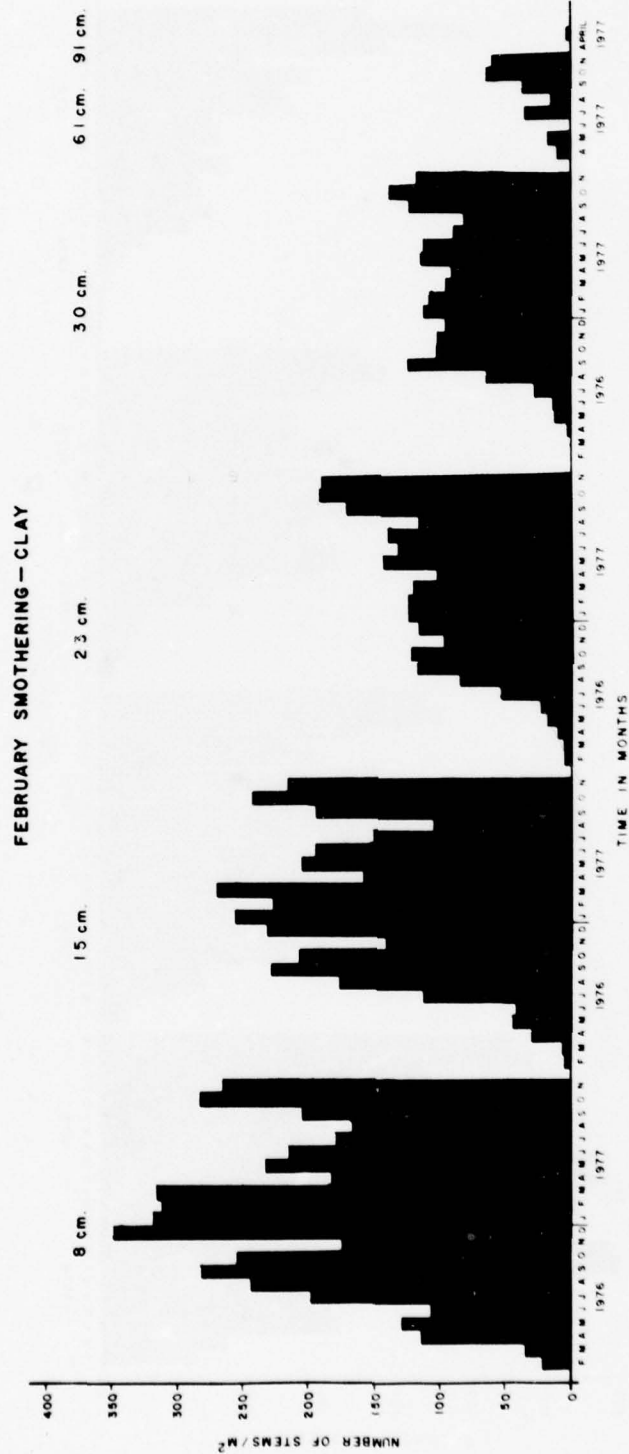


Figure 13. *S. alterniflora* culm density in experimental enclosures smothered with clay dredged material in February 1976.



of the sandy materials was the clay dredged material. The physical nature of the clay dredged material was more damaging to the underlying vegetation than were the sandy dredged materials. As the depth of dredged material increased, the initial culm density decreased as well as the time required to initiate recruitment.

28. After the February smothering operation, each of the dredged material types showed large density increases two months after filling (April) and again 5 to 7 months after filling (July - September) in the 8 cm enclosures. The 15 cm enclosures also manifested two peak recruitment periods, however, the April increase was much smaller and the July through September increase failed to attain culm density levels of the 8 cm enclosures for sand and clay and clay dredged material. The 23 and 30 cm enclosures experienced only small increases in culm density until July through September when rapid recruitment occurred. The initial response time for the 23 and 30 cm enclosures was 5 months instead of 2 months exhibited by the shallower fills. Culm densities were generally lower for the clay dredged material and the 30 cm enclosures had lower densities than the 23 cm enclosures. This suggested that depth of dredged material would be a primary determinant of marsh recovery. Figures 14 through 16 depict culm density recovery in each dredged material type four months after the February smothering operation.

29. The culm densities attained by the February filled 8 and 15 cm enclosures by the end of 1976 were in most cases the maximum culm density of the enclosures for the 2 year experimental period. Figure 17 depicts *Spartina alterniflora* recovery from the February filling of sand dredged material in November 1976. The 23 and 30 cm enclosures continued to show improvement over the entire experimental period. Figure 18 illustrated the lack of recovery of *Spartina alterniflora* in clay dredged material for a 61 cm enclosure filled in February 1976. After the smothering operation July and August produced large increases in culm densities in the filled enclosures, but during 1977 July and August were not peak recruitment periods for experimental or control areas. This indicated the increases were the result of the vegetation responding to the perturbation and not to seasonal population fluctuations.



Figure 14. *Spartina alterniflora* recovery four months after smothering with sand and dredged material.



Figure 15. *Spartina alterniflora* recovery four months after smothering with sand and clay dredged material.



Figure 16. *Spartina alterniflora* recovery four months after smothering with clay dredged material.



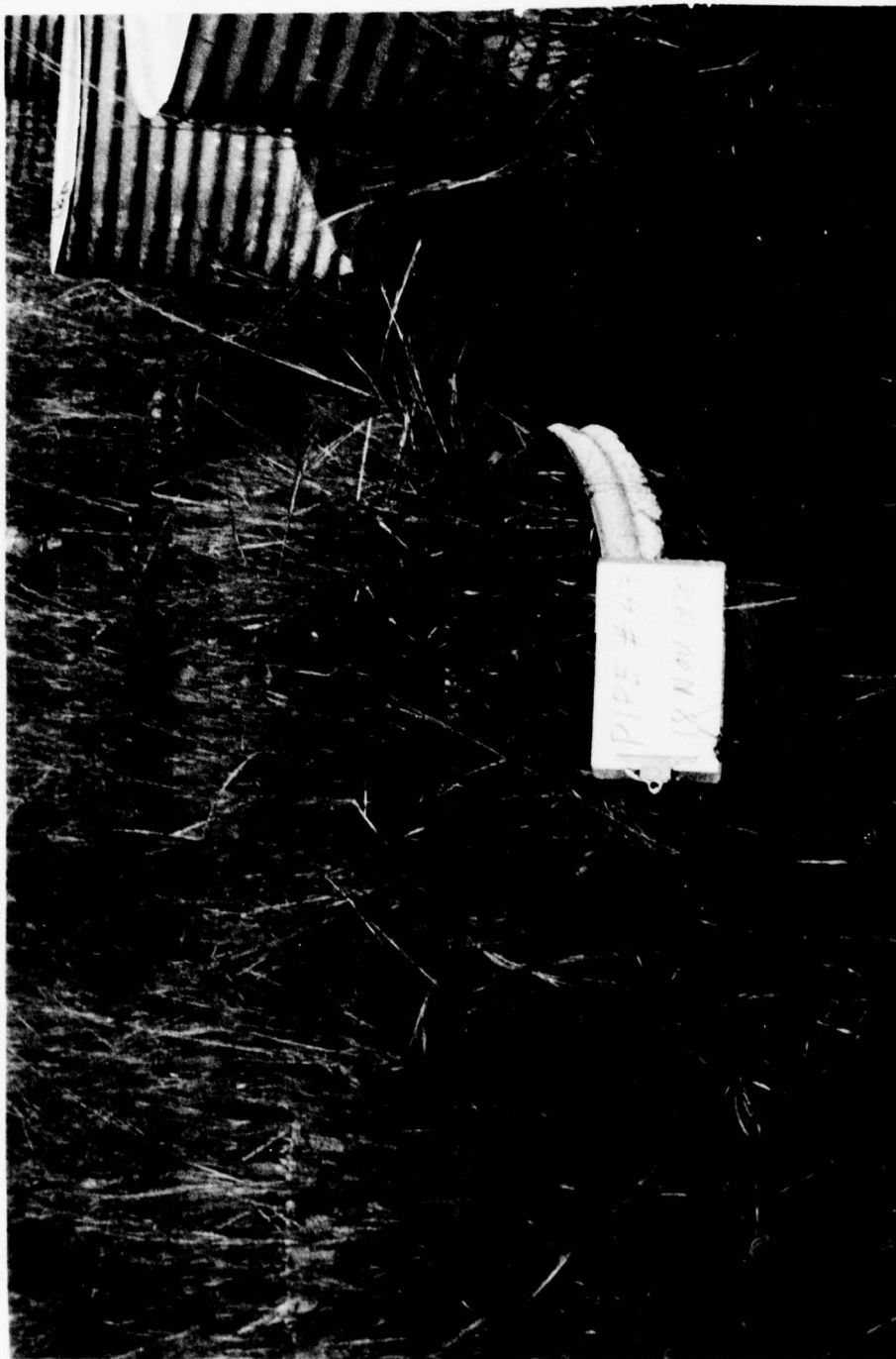


Figure 17. *Spartina alterniflora* recovery as of November 1976 in a 15 cm enclosure smothered in February 1976.

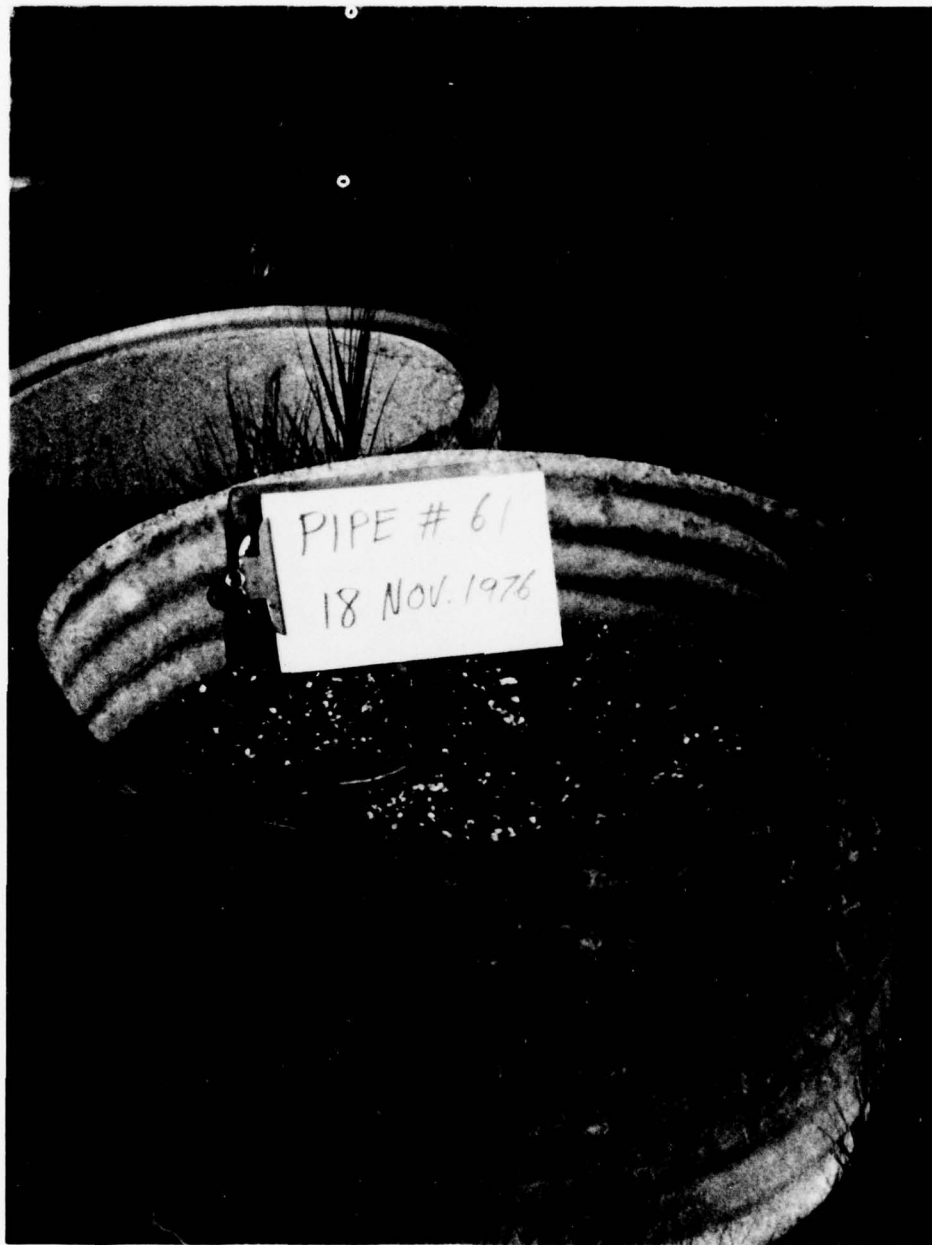


Figure 18. A 61 cm enclosure filled in February 1976 with clay dredged material showed no *Spartina alterniflora* recovery as of November 1976.

#### July 1976 Smothering

30. The July smothering operation produced no recovery in 61 and 91 cm enclosures for the two sandy dredged materials and limited seedling survival in the clay dredged material (Figures 19 through 21). This midseason filling operation found a higher proportion of tall *Spartina alterniflora* culms, consequently culm densities immediately after filling were higher than had been for the February filling. This was especially true for 15, 23 and 30 cm enclosures. The clay dredged material had lowest culm densities, the sand and clay was next and the sand dredged material showed the highest culm densities immediately after filling. Initial culm densities were successively less as the depths of the dredged material increased.

31. Recovery began almost immediately after the July smothering operation. The 8, 15 and 23 cm enclosures experienced rapid recruitment during August, September and October. Increases were as little as twice the initial density in sandy dredged material to as much as triple the initial density for the enclosures filled with clay dredged material. The magnitude of the density increases was slightly attenuated with increasing dredged material depth. The 30 cm enclosures had markedly lower densities and failed to manifest the rapid recruitment phase exhibited by the shallower enclosures. *Spartina alterniflora* appeared in the 61 and 91 cm enclosures during the second growing season as natural seedlings but only a small clump in a 91 cm enclosure filled with clay dredged material managed to survive to the completion of the experiment.

32. The rapid culm density increase during August through October for the 8 cm enclosures produced the greatest culm densities for the sand and the clay dredged material. The sand and clay dredged material produced maximum densities in the spring of 1977. The 15 cm enclosures filled with sand and sand and clay dredged material yielded maximum densities in October 1976. The 23 and 30 cm enclosures demonstrated a more gradual density increase with time. Many of the 23 and 30 cm enclosures had attained maximum density at the end of the experimental period in the fall of 1977. By the end of the experiment the culm

# JULY SMOTHERING - SAND

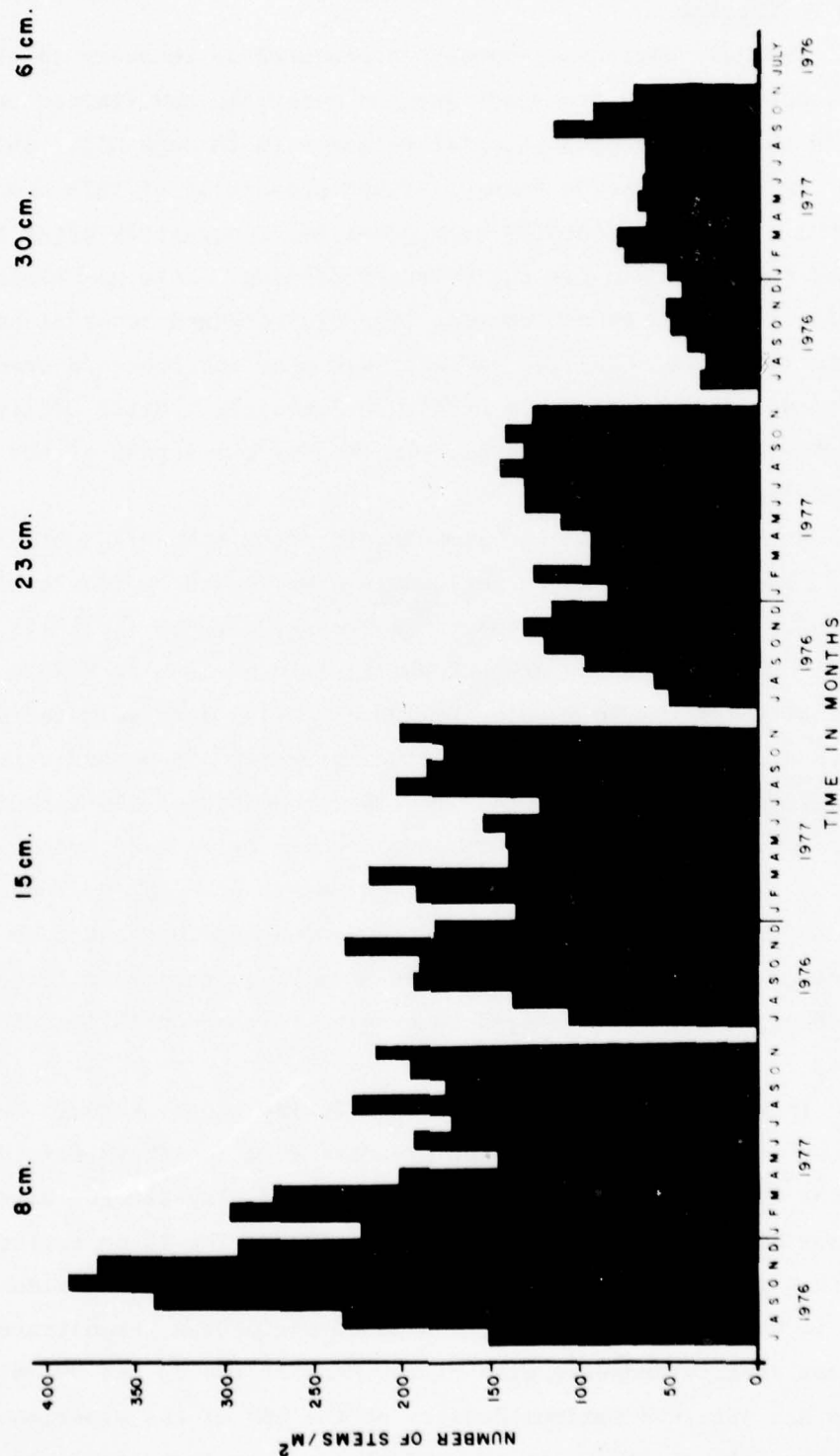


Figure 19. *S. alterniflora* culm density in experimental enclosures smothered with sand dredged material in July 1976.



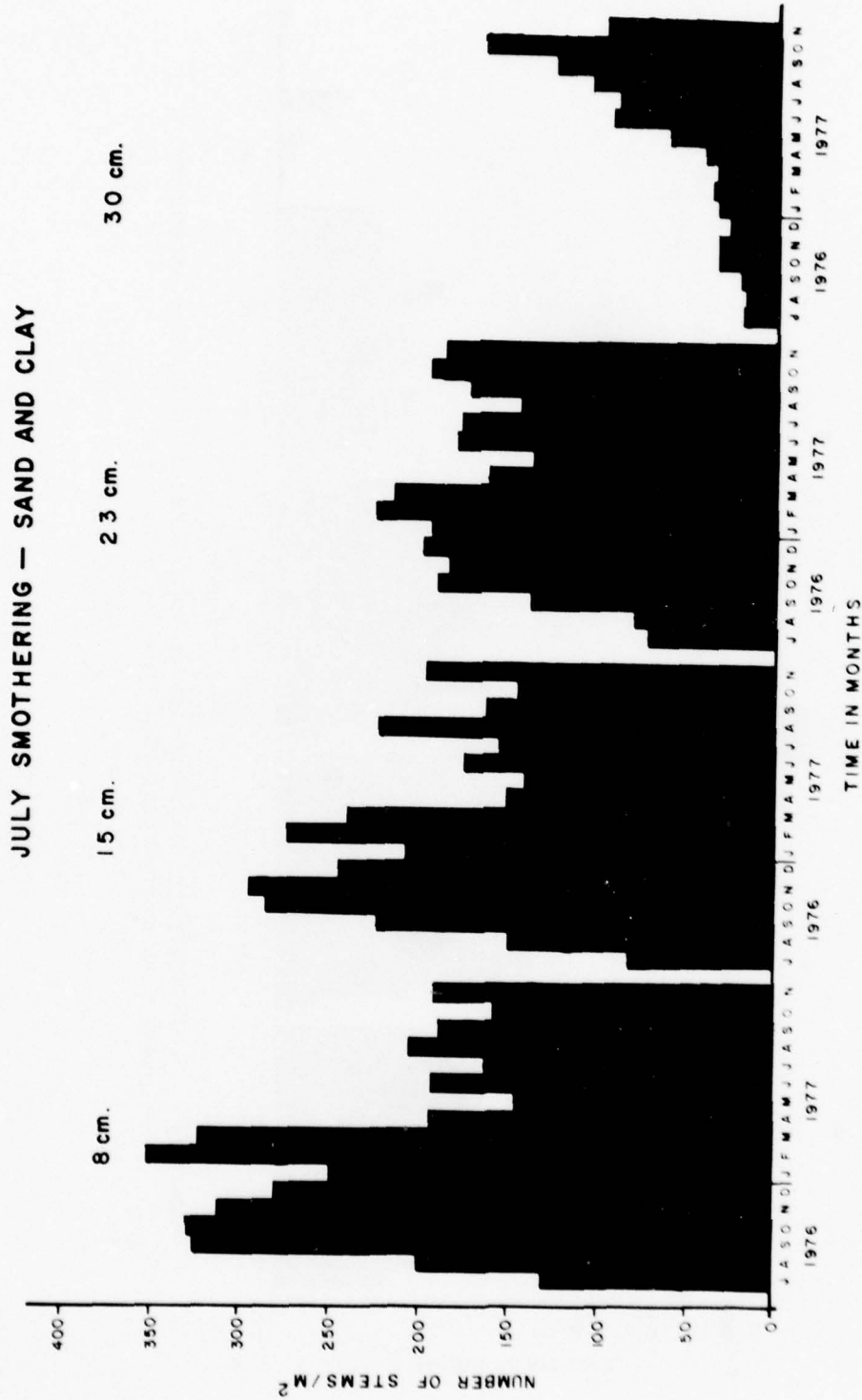


Figure 20. *S. alterniflora* culm density in experimental enclosures smothered with sand and clay dredged material in July 1976.

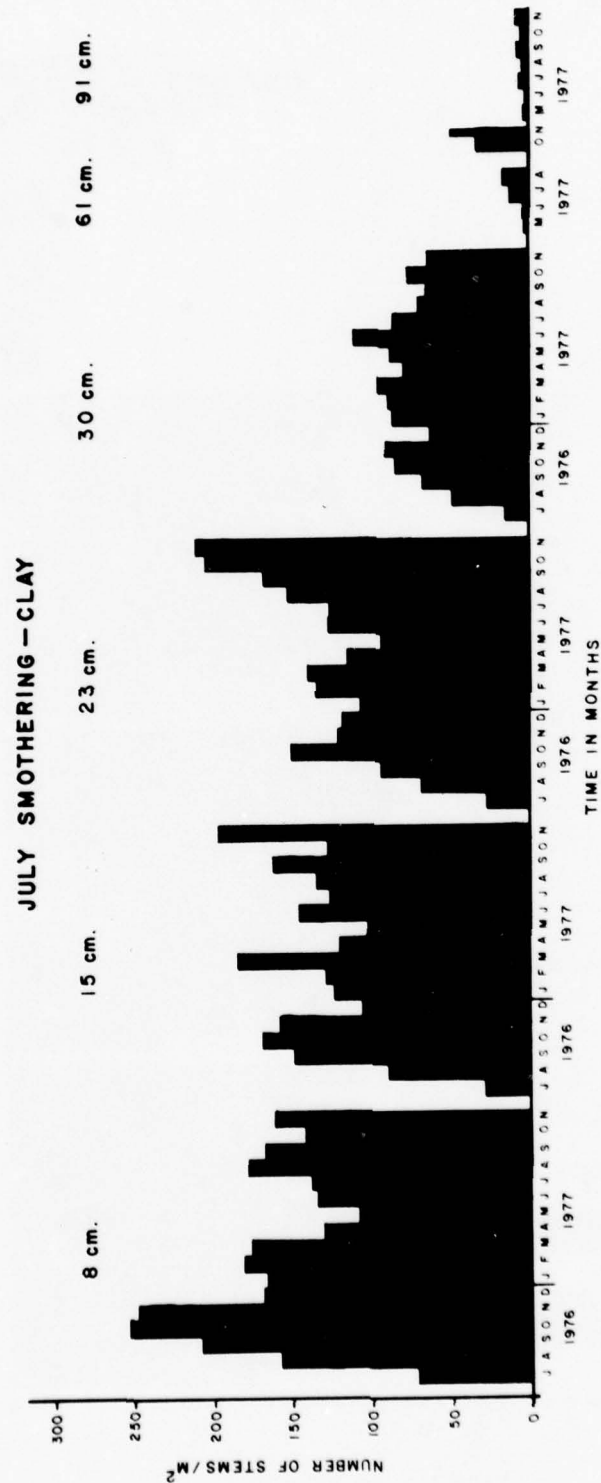


Figure 21. *S. alterniflora* culm density in experimental enclosures smothered with clay dredged material in July 1976.

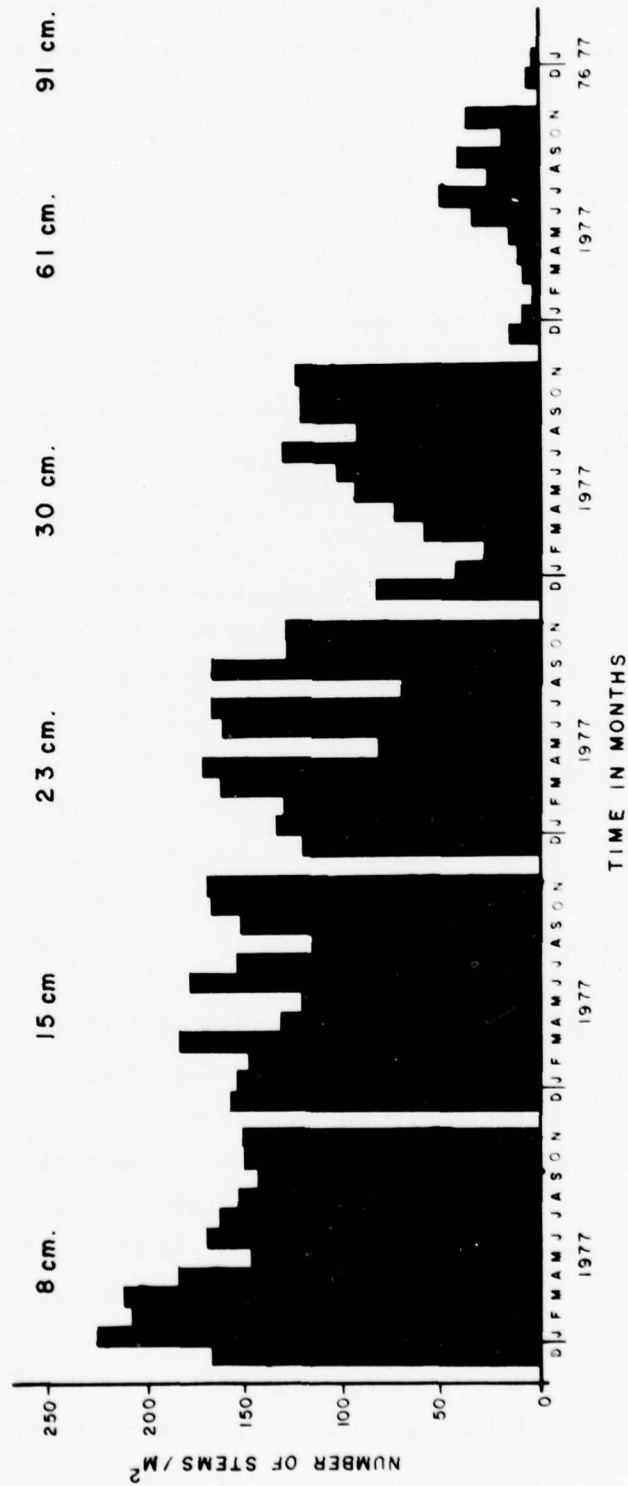
densities of the 8, 15 and 23 cm enclosures were nearly identical for each dredged material type. The 30 cm enclosures had somewhat lower culm densities, but had attained comparable density levels in each of the dredged material types. Overall culm density levels for the July smothering operation were less than the culm densities produced by the February smothering operation.

#### November 1976 Smothering

33. The enclosures smothered in November 1976 for each dredged material type are depicted in Figures 22 through 24. No recovery was noted for the 91 cm enclosures filled with sand and sand and clay dredged materials. By November many of the *Spartina alterniflora* culms inside the unfilled enclosures had attained maximum height and many produced seedheads. The greater proportion of tall culms yielded the high culm densities in the 8 through 30 cm enclosures immediately after smothering. The 8 cm enclosures contained over 150 culms/m<sup>2</sup> for each dredged material type immediately after smothering. The initial density was higher than either the February or the July filling dates. Density increases were relatively small thereafter with the largest increases occurring the following spring (February through April 1977). The 15 and 23 cm enclosures followed much the same pattern set by the 8 cm enclosures. The initial densities were somewhat lower for the 15 and 23 cm enclosures, however, by the spring of 1977 culm densities were essentially identical. The 30 cm enclosures experienced a sizable increase in culm densities during the spring of 1977, but regained initial density levels during the summer of 1977. Culm densities in the 61 and 91 cm enclosures were the result of tall *Spartina alterniflora* culms, usually with seedheads, extending above the filled enclosures. The culm density increases in the 61 cm enclosures during the spring and summer of 1977 were the result of seedling survival on the surface of the dredged material. Therefore, the response measured by culm density was not a true indicator of recovery from a smothering operation.

334. The 8, 15, and 23 cm enclosures attained similar culm densities by the end of the experimental period for each of the dredged material types. The 30 cm enclosures filled with sand and sand and clay

# NOVEMBER SMOTHERING — SAND





# NOVEMBER SMOTHERING - SAND AND CLAY

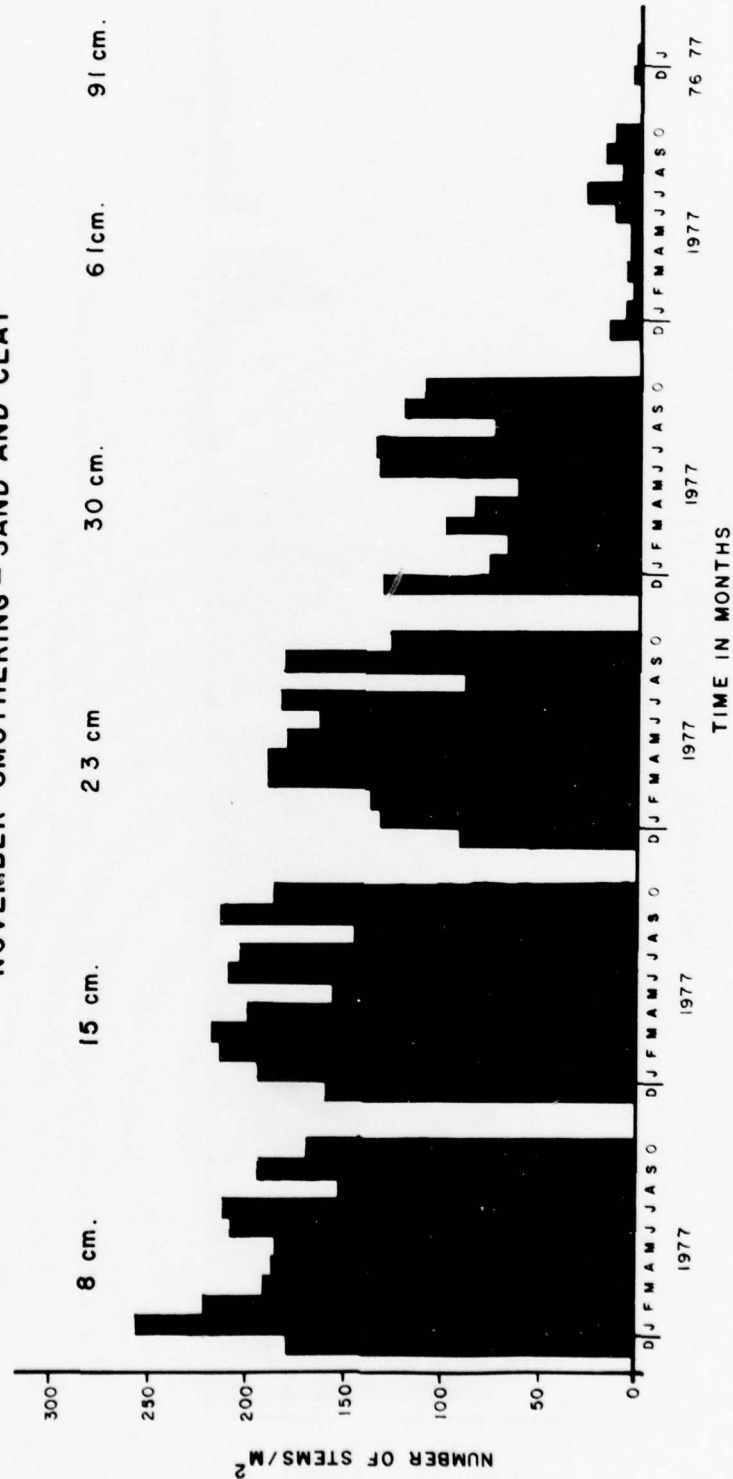


Figure 23. *S. alterniflora* culm density in experimental enclosures smothered with sand and clay dredged material in November 1976.

# NOVEMBER SMOTHERING - CLAY

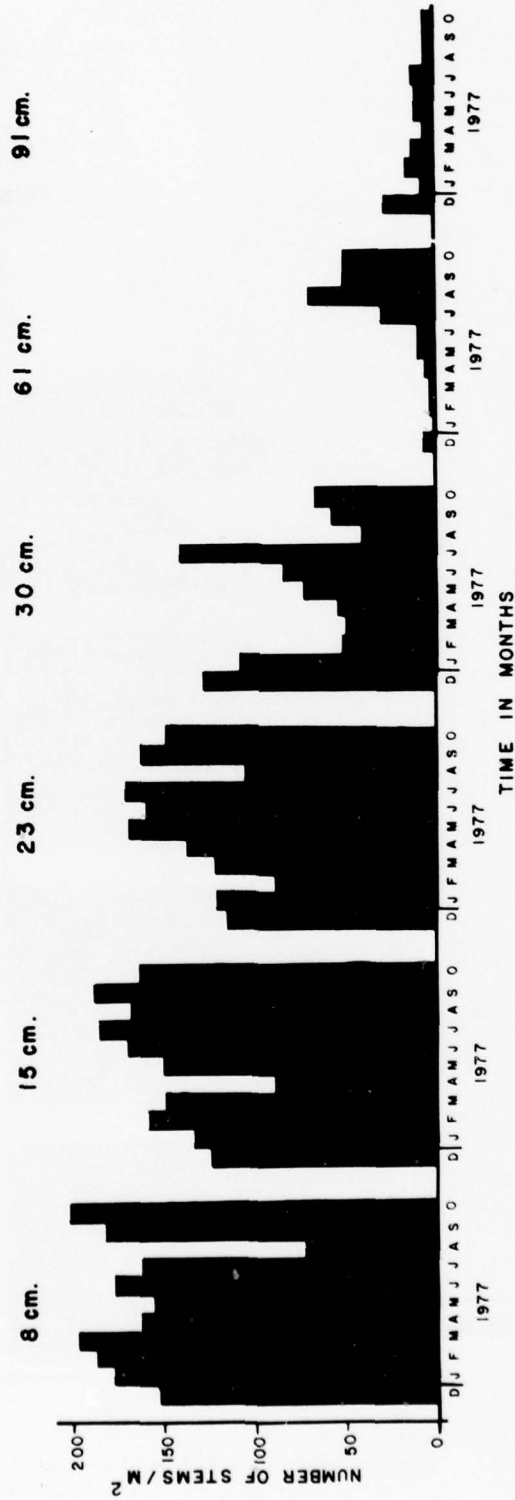


Figure 24. *S. alterniflora* culm density in experimental enclosures smothered with clay dredged material in November 1976.

dredged material yielded similar culm densities which were slightly less than the 23 cm enclosures. The 30 cm enclosures filled with clay dredged material exhibited significantly lower culm densities than the other 30 cm enclosures. Overall the sand and clay dredged material produced the highest culm densities for the November smothering. The culm densities produced in response to the November filling were similar to the July filling culm densities. The February filling yielded the highest culm densities of all filling months, however, by the end of the experimental period only small density differences separated the filling months for each dredged material and enclosure height.

#### Control Areas

35. Figures 25 and 26 depict the culm densities of the control enclosures and of the adjacent *Spartina alterniflora* marsh. The 8 through 61 cm control enclosures maintained similar culm densities over the experimental period. The 91 cm enclosures revealed a marked reduction in culm density. The culm densities of all enclosure heights decreased with time. The year after insertion of the enclosures, culm densities increased rapidly for all heights, but the second year yielded attenuated densities from the previous year. Restriction of tidal inundation, ground water movement or incident sunlight may have contributed to the initial density peak and subsequent density reduction. The adjacent marsh exhibited a similar culm density pattern, however, the densities were a mean of five random quadrats and did not measure the same areas each month as did the control enclosures. Initially the control enclosures maintained higher culm densities than the adjacent marsh and near the end of the experimental period the enclosure controls yielded lower culm densities than the adjacent marsh.

#### Models

36. The significance of the experimental treatments (height = enclosure height, soil = dredged material type, and month = filling date) as determined by culm density are found in Table 3. Culm density showed significant mean differences for all treatments and treatment combinations.

37. The treatment of enclosure height (depth of dredged material placed over the marsh) was significant at the 99.99 percent confidence

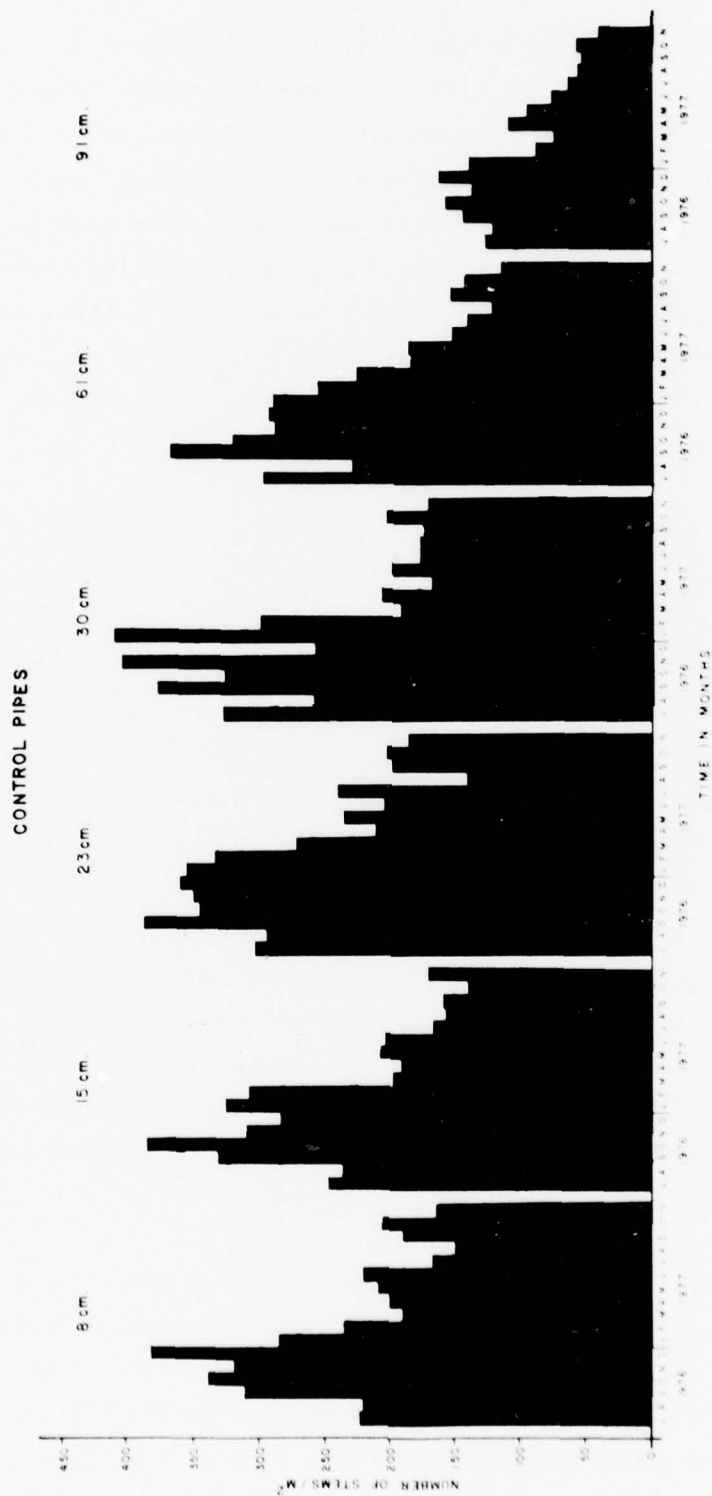


Figure 25. *S. alterniflora* culm density in control enclosures.



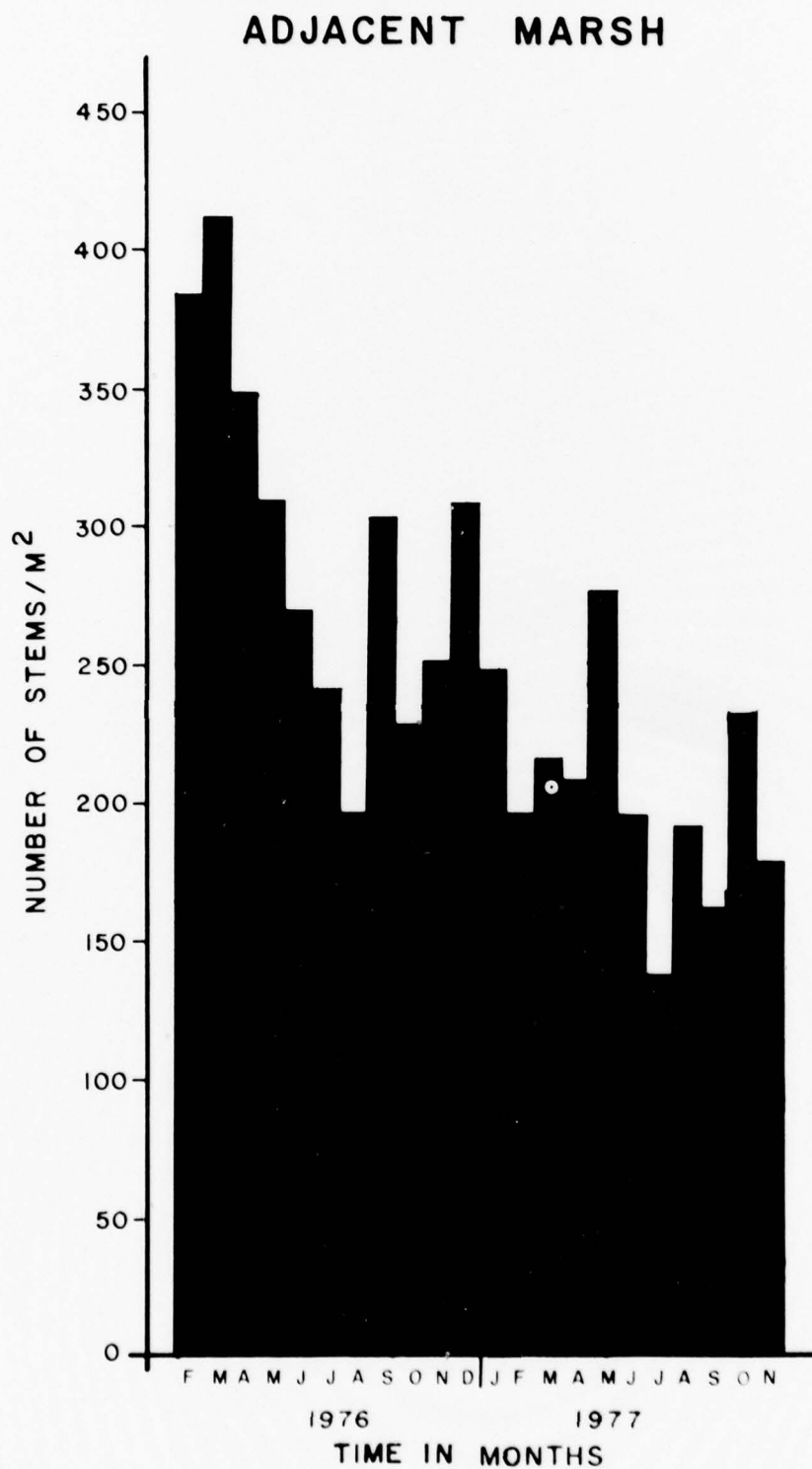


Figure 26. *S. alterniflora* culm density in adjacent marsh control areas.

TABLE 3

Significance of Treatments from  
the Analysis of Variance for Dependent  
Variables in the Marsh Smothering Enclosures

Treatment	MARSH SNAILS				
	Live Culms /m <sup>2</sup>	Live Crabs /m <sup>2</sup>	Crab Burrows /m <sup>2</sup>	<i>Littorina irrorata</i> /m <sup>2</sup>	<i>Melampus bidentatus</i> /m <sup>2</sup>
Height	****	****	****	****	****
Soil	****	****	****	NS	NS
Height x Soil	****	****	****	NS	NS
Month	****	NS	NS	***	****
Height x Month	****	NS	NS	****	****
Soil x Month	**	NS	NS	NS	NS
Height x Soil x Month	****	NS	***	NS	NS

Probability level: NS = not significant \* = 0.05 \*\* = 0.01 \*\*\* = 0.001 \*\*\*\* = 0.0001.

interval. The mean culm density for the 8 through 61 cm enclosure heights were significantly different from each other (Table 4). The 91 cm enclosure fill density was significantly different from all other heights except 61 cm. The orderly gradation of decreasing culm density with the increasing fill depth, illustrated the primary importance of fill depth indetermining recovery of a marsh. Culm densities recorded for the 61 and 91 cm enclosure heights were partly the result of tall culms protruding through the surface of the fill and partly from *Spartina alterniflora* seedlings being established via windborne seeds or, for the November filling date, from seed heads which protruded the surface of the fill. Culm densities resulting from such circumstances were not a true indicator of marsh recovery from a filling operation but suggested the ability of *Spartina alterniflora* to colonize barren areas resulting from dredged material disposal. Culm density and flowering culm density changes over time for each enclosure height, soil and month are depicted in Appendix B.

38. Significant differences of mean culm density for each soil type are depicted in Table 5. Although the means were similar, the sand and clay dredged material produced the highest culm densities. The sand dredged material yield the second highest density and the clay dredged material produced the lowest mean density. The actual mean differences were not great; however, the lower mean density for the clay dredged material may be indicative of the nearly impenetrable layer formed by the dry clay material. This physical characteristic of the dredged material may have impeded the plant recovery.

39. The next treatment tested was that of month or the time during the growing season best suited to recovery from a filling operation. The beginning of the growing season (February) produced the highest overall culm density with the November filling second and the mid-growing season (July) showing the lowest recovery density. The actual mean differences among the three filling periods was small. The staggered filling dates produced differences in the time available for each treatment to recover; therefore, the February filling had the longest time period in which to manifest a recovery. The different time interval allotted for each filling date to recover may have contributed to the significant differences

TABLE 4

Means of Measured Variables by Enclosure Height

Height (cm)	MARSH SNAILS				
	Live Culms /m <sup>2</sup>	Live Crabs /m <sup>2</sup>	Crab Burrows /m <sup>2</sup>	<i>Littorina</i> <i>irrorata</i> /m <sup>2</sup>	<i>Melampus</i> <i>bidentatus</i> /m <sup>2</sup>
8	218 a	3.10 a	24.1 a	0.14 a	4.50 a
15	185 b	0.70 b	8.9 b	0.13 a	2.80 b
23	149 c	0.50 b	7.4 b	0.05 b	0.80 c
30	93 d	0.10 b	1.8 c	0.04 b	0.17 c
61	7 e	0.01 b	0.01 c	0.00 b	0.00 c
91	1 e	0.00 b	0.006 c	0.00 b	0.00 c

Means followed by similar letters were not significantly different at  $p = 0.05$  according to Duncan's Multiple Range test.



TABLE 5

Means of Measured Variables by  
Soil Type, Month of Smothering and Enclosure Type

SOIL TYPE	Live Culms /m <sup>2</sup>	Live Crabs /m <sup>2</sup>	Crab Burrows /m <sup>2</sup>	MARSH SNAILS	
				<i>Littorina</i> <i>irrorata</i> /m <sup>2</sup>	<i>Melampus</i> <i>bidentatus</i> /m <sup>2</sup>
Sand	108.4 b	0.3 b	1.9 b	0.05 a	1.4 a
Sand and Clay	116.0 a	0.3 b	2.1 b	0.05 a	1.2 a
Clay	101.6 c	1.5 a	17.0 a	0.07 a	1.5 a
-----					
MONTH					
February	123.5 a	0.6 a	6.5 a	0.10 a	2.2 a
July	98.1 b	0.7 a	7.5 a	0.02 b	1.3 b
November	102.2 b	0.8 a	7.1 a	0.06 ab	0.2 c
-----					
Enclosure Type					
Experimental	109.0 b	0.7 b	7.1 a	0.06 b	1.4 b
Control	189.0 a	2.8 a	9.7 a	0.30 a	4.5 a
-----					
Experimental	109.0 b	0.7 b	7.1 a	0.06 a	1.4 b
3m x 3m	234.0 a	3.5 a	16.1 a	0.20 a	17.2 a
-----					
Experimental	109.0 b	0.7 b	7.1 b	0.06 b	1.4 b
Adjacent Marsh	201.0 a	4.8 a	40.9 a	0.80 a	6.0 a

Means followed by similar letters were not significantly different at  
p = 0.05 according to Duncan's Multiple Range test.

described by the model. Further investigation by way of density comparisons to control areas was required to determine more accurately the time interval necessary to full recovery.

40. The combinations of the treatments of height, soil and month all showed significant differences among mean culm densities. As indicated previously, actual mean differences were small for those interactions including soil and month (Appendix A). The density differences were most pronounced when described by height.

#### Live Crab and Crab Burrow Density

41. The significant treatments from the analysis of variance for live crabs and crab burrow densities are found in Table 3. The treatments of height, soil and height x soil were significant for both live crabs and crab burrows. The favorable comparison of the models derived from the two different measures of crab activity suggested both to be reasonable estimates of crab presence and activity.

42. Differences in enclosure height yielded significant differences in live crab and crab burrow density (Table 4). The 8 cm enclosures had a mean crab and crab burrow density significantly higher than any other height. For live crab density the 15 through 91 cm enclosures showed significantly lower mean densities than the 8 cm enclosures and crab burrow density was significantly lower for the 30 through 91 cm enclosure heights. Immediately after filling with dredged material, all heights of enclosures displayed burrowing activity, however, the heights of 30 cm and higher lacked any protective vegetation or surface root mat necessary to maintain a moist surface soil layer, thus the surface layers quickly dessicated and the collapsing burrows left the crabs stranded at the surface. Large numbers of dead crabs were seen at the tops of the taller enclosures several days after filling. In the shorter enclosures, sufficient moisture from the underlying marsh and from tidal waters flooding the enclosures maintained the soil moisture such that the crabs were able to survive. Large cracks in the clay substrate provided easy access to deep, cool areas suitable for the survival of the crabs. These

special conditions contributed to the continued survival of the crabs in the taller enclosures for the clay dredged material.

43. The second significant treatment was that of soil. The physical dessication of the upper surface layers of dredged material was directly related to height above the marsh surface; however, all the dredged material types were not equally susceptible to the rapid drying. Both the sand and the sand and clay mixture dried very quickly leaving crumbled burrows and crabs trapped on the surface. The clay dredged material retained moisture and remained consolidated much longer thus providing a more favorable substrate for crab burrows. In addition to being a better burrowing substrate, the clay dredged material was also compatible in terms of particle size distribution with the underlying marsh soil. The major crab population before filling was *Uca pugnax*, the mud fiddler. *Uca pugnax* have mouthparts adapted to feeding from silt and clay particles and thus were best adapted to surviving in a comparable substrate. Even if these mud fiddler crabs were able to survive in the sandy dredged materials, they would have likely starved, lacking the ability to feed in those substrates.

44. The superiority of the clay dredged material in maintaining a crab population was documented in the analysis of variance for the soil treatment. The mean crab burrow density for the clay dredged material was significantly higher than either of the sand dredged materials (Table 5). Crab burrow densities in enclosures with 30 cm or less of dredged material were most abundant in the clay dredged material (Appendix A). The 8 and 15 cm enclosures were the only heights having any appreciable crab burrow density for the sandy dredged materials. Extremely low crab burrow densities were recorded for even the 8 and 15 cm enclosures containing the sandy dredged materials for nearly a year after filling. During this time the increased culm densities of *Spartina alterniflora*, and associated canopy provided a trap for sediments carried over the plots at high tide and fostered a renewed microbial population. These changes of the dredged material surface attracted greater numbers of *Uca pugilator* and *Sesarma reticulatum* to the area. Changes such as these document the importance of the dredged material in determining crab

distribution. Inspection of the means of crab burrow densities at the various enclosure heights documented a strong relationship to enclosure height as did the culm density. It was not clear from this analysis whether the crab burrow densities decrease with enclosure height was a function of culm density or if both measurements are similarly related to elevational changes.

45. The remaining treatment combinations including month (Table 3) showed no significant differences. The effect of month of filling was not great enough to produce any significant differences in crab burrow densities singularly or in combination. Live crab and crab burrow density changes with time in each of the experimental and control areas are depicted in Appendix B.

#### Marsh Snail Density

46. The model constructed to test the treatments of height, soil and month was similar to those previously discussed except that significant differences attributable to the treatments were measured in terms of snail population densities. The first model considered the population density of *Littorina irrorata*. The population densities recorded in the experimental enclosures never equaled the densities of surrounding marsh areas. The densities of *Littorina irrorata* were lower in 1977 than had been in 1976 soon after the filling operations. The reason for the decline is not clear, but may be due to the extremely cold winter of 1977 and not to experimental treatments since adjacent marsh populations were also low.

47. The first treatment tested (Table 3) was the impact of different depths of dredged material on the snail populations. *Littorina irrorata* had significant differences in population density with height. The mean snail densities for 8 cm and the 15 cm enclosures were not significantly different, however, both were significantly higher than either the 23 cm or the 30 cm enclosures (Table 4). The 61 and 91 cm enclosures had no *Littorina irrorata* at any time after the filling operation. The density values were low for all experimental areas, but



the 8 and 15 cm enclosures represented a good potential for marsh periwinkle recovery.

48. The effects of dredged material type (soil) produced no significant difference in mean densities (Table 5). Treatments of month of filling and enclosure height x month of filling showed significant differences. Inspection of the month of filling means revealed February to have the highest mean density of *Littorina irrorata* (Table 5). It should be noted that the *Littorina irrorata* population density followed the same pattern as that of culm density for the month treatment. The snail density means for the month of filling x enclosure height reflected the patterns set forth by enclosure height (decreasing density as height increases) and by month of smothering (February attained highest density). The inclusion of soil type was ineffective in yielding any significant difference among *Littorina irrorata* density means.

49. The model for *Littorina irrorata* followed the pattern of significant treatments similar to that of culm density. This indicated either the dependence of marsh plant culm density and marsh periwinkle density upon the significant treatments or the dependence of the snail population upon the surviving vegetation. The latter was most probably the case in light of the feeding habits of *Littorina irrorata* (Smalley 1958).

50. The other snail population monitored was *Melampus bidentatus*, the coffee bean snail. Population densities for the coffee bean snail in adjacent marshes were much higher than the marsh periwinkle. *Melampus bidentatus* were observed primarily on the dead portions of plant stalks or on the marsh surface. Inspection of the dead sheaths of a number of live *Spartina alterniflora* culms revealed the occasional occurrence of a number of (5-10) of very small *Melampus bidentatus* snails imbedded in the sheaths. The population density counts from each of the enclosures did not include the inspection and subsequent enumeration of snails embedded in the sheaths. Only those snails observed occupying surface areas were included. The lengthy time required and possible physical damage to the culms warranted a superficial monitoring technique.

51. The treatment of enclosure height yielded significant differ-

ences in mean densities of *Melampus bidentatus* (Table 3). The snail densities at the 8 and 15 cm filling depths were significantly higher than the taller enclosures (Table 4). Previous observations suggested the frequent occurrence of *Melampus bidentatus* on the marsh surface to be related to the moist microclimate associated with the marsh vegetation and daily tidal inundation. The absence of this microclimate in the 23 and 30 cm enclosures suggested an explanation for the attenuated snail densities. As with *Littorina irrorata*, no *Melampus bidentatus* survived in the 61 and 91 cm enclosure heights.

52. The treatments of dredged material type and dredged material x enclosure height were not significant (Table 5) for *Melampus bidentatus* density; however, the treatments of month and month x enclosure height were significant at the 0.0001 level. The mean snail densities for filling month were February ( $2.2/\text{m}^2$ ), July ( $1.3/\text{m}^2$ ) and November ( $0.2/\text{m}^2$ ). The population densities for *Melampus bidentatus* were ordered differently from the marsh periwinkle and seemed to be more a function of time than dependency upon culm density. Mean differences for the month x enclosure height reflected the time factor expressed in the month means in that for every height the February filling had the maximum density and the October filling the minimum density (Appendix A). *Littorina irrorata* and *Melampus bidentatus* density changes with time for each treatment combination are depicted in Appendix B.

#### Enclosure Controls

53. Using data from the same time period as the previous models (November 1976 through November 1977) an analysis of variance was performed for all control enclosures and all experimental enclosures. Control enclosures included 3 replicates of each enclosure height and were unfilled  $0.656 \text{ m}^2$  enclosures. Experimental enclosures consisted of all filled enclosures. The treatment term for the model was the enclosure type. A complete summary of the analysis of variance can be found in Appendix A.

54. The first variable, culm density, was significant at the 0.0001

level. The control mean culm density of  $189.5/\text{m}^2$  was significantly higher than the experimental mean of  $109/\text{m}^2$  (Table 5). This evaluation suggested that the experimental treatments of filling had in fact reduced culm density. Live crab density for control areas was significantly higher than crab densities recorded for experimental areas. Crab burrow densities for control and experimental areas were not significantly different at the 0.05 level. The crab burrow densities of  $9.7/\text{m}^2$  (control) and  $7.1/\text{m}^2$  (experimental) exemplifies the ability of fiddler and square-back crabs to withstand and recolonize areas perturbed by dredged material deposition. Significantly higher mean densities were exhibited by the marsh periwinkle (*Littorina irrorata*) and coffee bean snail (*Melampus bidentatus*) for control enclosures than for experimental enclosures (Table 5). The comparison of control enclosures to experimental enclosures by height confirmed the reduction of all measured populations except crab burrow density after deposition of dredged material (Appendix A).

#### Adjacent Marsh Controls

55. A summary of the analysis of variance and mean densities for each dependent variable for experimental and adjacent marsh areas is found in Appendix A. Significant differences for culm densities in experimental enclosures and adjacent marsh areas demonstrated the reduction of culm densities by the experimental treatments (Table 5). Mean culm density for enclosure controls ( $189/\text{m}^2$ ) was slightly lower than the culm density for the adjacent marsh controls ( $201/\text{m}^2$ ) suggesting the possibility of the enclosures reducing culm densities slightly. A comparison of enclosure controls by enclosure height and the adjacent marsh controls revealed only the 61 and 91 cm enclosure controls to have lower culm densities than the adjacent marsh. Live crab densities and crab burrow densities were significantly different for experimental and natural marsh areas. Live crab densities of  $0.9/\text{m}^2$  for experimental and  $4.8/\text{m}^2$  for adjacent marshes and crab burrow densities of  $7.2/\text{m}^2$  for experimental and  $40.9/\text{m}^2$  for adjacent marshes, illustrated a large de-

crease in the crab populations in the experimental enclosures. Significant differences in mean population densities of *Littorina irrorata* existed between the experimental enclosures ( $0.09/\text{m}^2$ ) and the adjacent marsh areas ( $0.75/\text{m}^2$ ). *Melampus bidentatus* showed significant differences in mean density for experimental enclosures ( $1.7/\text{m}^2$ ) and adjacent marsh areas ( $6.0/\text{m}^2$ ). The adjacent marsh controls population densities for both *Littorina irrorata* and *Melampus bidentatus* were higher than the densities recorded for the enclosure controls suggesting the enclosures had affected the snail population densities.

#### 3m x 3m Enclosure Controls

56. The analysis of variance yielded significant differences for means of culm, live crabs, and *Melampus bidentatus* population densities between experimental enclosures and 3m x 3m enclosure controls (Appendix A). The culm density for the 3m x 3m enclosure controls was similar to both the adjacent marsh and enclosure controls suggesting that the 3m x 3m enclosure was not affecting the culm density. Live crab density produced significant mean density differences between the 3m x 3m enclosures and the experimental enclosures (Table 5). The experimental enclosures mean crab density ( $0.9/\text{m}^2$ ) and the 3m x 3m enclosure control mean crab density ( $3.5/\text{m}^2$ ) exemplified the differences suggested by the model. Crab burrow densities were not significantly different between experimental and 3m x 3m enclosures. The mean burrow density was greater for the 3m x 3m enclosures than for experimental enclosures; however, the low number of replicates for the 3m x 3m enclosures negated a significant difference.

57. No significant differences between experimental and 3m x 3m enclosure control means were noted for *Littorina irrorata*. *Melampus bidentatus* had a significantly higher mean density in the 3m x 3m enclosure than in the experimental areas.

58. A comparison of adjacent marsh controls and the 3m x 3m enclosure controls revealed mean plant culm density and *Melampus bidentatus* density were higher for the 3m x 3m enclosure control. The lower



densities of live crabs, crab burrows and *Littorina irrorata* in the 3m x 3m enclosures suggested a possible restriction of normal population movements had been imposed by the enclosure walls.

#### Summary

59. The effect of the depth of dredged material placed over a marsh was the primary determinator of the degree of marsh recovery as measured by culm density. The effect of month of deposition produced highest culm densities for the February filling. The month of deposition resulted in different recovery intervals for each filling month and may have been more of a factor in the density differences than the treatment itself. The treatment of dredged material type showed sand and clay to have the greatest culm density. The actual differences between culm density means for each of the dredged material types was small suggesting a longer recovery period may negate any differences.

60. Crab burrow density and live crab density both documented enclosure height and soil as the significant treatments controlling fiddler and square back crab populations. Initially, the inability of the crabs to maintain burrows in the sandy dredged materials limited their distribution. As the surface consistency of these dredged materials was changed by the accumulation of silt and clay particles, the crab populations were able to recolonize the areas. The similarity of the clay dredged material to the underlying marsh resulted in significantly higher burrow and live crab densities at all enclosure heights for the clay dredged material. The initial population of *Uca pugnax* crabs was replaced by *Uca pugilator* and *Sesarma reticulatum* in the two sandy dredged materials. Crab burrow density varied inversely to enclosure height, much the same as culm density. Live crab and crab burrow densities failed to describe any significant differences to month of smothering.

61. The two marsh snails exhibited similar significance to the treatment interactions, namely; enclosure height, month, and enclosure height x month. Culm density was significant for the same treatment

interactions suggesting the dependence of both species of snails upon the presence of sufficient vegetation to provide habitat for their survival. Dredged material type was a significant factor in determining crab burrow density but failed to produce any significant differences for either snail population. This illustrated different environmental factors to be controlling snail populations than were controlling crab populations. Lower overall mean density for both species of snails in the experimental as well as control areas in 1977 indicated factors other than the experimental treatments to account for the decreases.

62. A comparison of the three control types revealed both the enclosure controls of 30 cm or less and the 3m x 3m enclosure controls to have slightly higher culm densities than the adjacent marsh controls. This may be an indication of a container effect causing the higher density of *Spartina alterniflora* culms. Enclosure controls of 61 and 91 cm exhibited attenuated culm densities probably due to the restriction of incident sun light. The adjacent marsh control areas yielded higher densities of live crabs, crab burrow and *Littorina irrorata* than either size of enclosure controls. The 3m x 3m enclosure control had higher densities of *Melampus bidentatus* than either the adjacent marsh or the enclosure controls. The restrictive nature of the enclosure walls was least evident for the *Spartina alterniflora* culm density and most evident in the mobile populations of crabs and snails.

#### PART IV: PLANT PERFORMANCE (BIOMASS)

63. This part deals with biomass measurements estimated from  $0.05\text{m}^2$  quadrats placed within each experimental enclosure and all control areas. Biomass was estimated using the linear regression equations described in the Materials and Methods section (Part II) utilizing the sum of the heights (cm) of all live or dead culms found within the quadrats. Live and dead culm densities were also monitored within each quadrat. The quadrats were stationary and were measured in April 1977 and again in November 1977. All biomass values were expressed as  $\text{gdw/m}^2$  and culm densities as  $\text{culms /m}^2$ .

64. The biomass estimates for the control enclosures and adjacent marsh controls were estimated using the regression equations as were the experimental enclosures, thus, comparisons among the three would provide a relative indicator of recovery success based on biomass.

##### Standing Crop Biomass

##### April 1977

65. The enclosures filled with the sand dredged material monitored in April 1977, are found in Table 6. Differences of mean standing crop biomass (of combined live and dead tissue) by height class revealed the 8 and 15 cm enclosures to be similar for each of the filling months. The 23 and 30 cm enclosures showed live and dead biomass declined with increased enclosure height and declined with later filling months. Except for the February fill, there was pronounced reduction in biomass in the 23 cm and taller enclosures. Figure 27 depicted live and dead standing crop biomass for the *Spartina alterniflora* marsh adjacent to the study area determined by destructive harvest techniques. The live or dead standing crop

TABLE 6

## MARSH SMOTHERING EXPERIMENTAL ENCLOSURES

ESTIMATED COMBINED LIVE AND DEAD STANDING CROP BIOMASS  
AND CULM DENSITY FROM PERMANENT 0.05 m<sup>2</sup> QUADRATS

Substrate type:	APRIL 1977					
	SAND					
	FEBRUARY		JULY		NOVEMBER	
Month of filling:	mean culm density/m <sup>2</sup>	mean standing crop biomass gdw/m <sup>2</sup>	mean culm <sup>2</sup> density/m <sup>2</sup>	mean standing crop biomass gdw/m <sup>2</sup>	mean culm <sup>2</sup> density/m <sup>2</sup>	mean standing crop biomass gdw/m <sup>2</sup>
8 cm.	260	812.9	340	896.3	320	703.3
15 cm.	326	1001.6	220	630.7	200	708.4
23 cm.	220	748.3	126	426.5	130	247.8
30 cm.	180	494.0	70	288.2	60	122.4
61 cm.	0	0	0	0	0	0
91 cm.	120	297.1	0	0	0	0



# MEAN STANDING CROP BIOMASS OF *S. alterniflora*

MARSHES ADJACENT TO MARSH SMOTHERING SITE

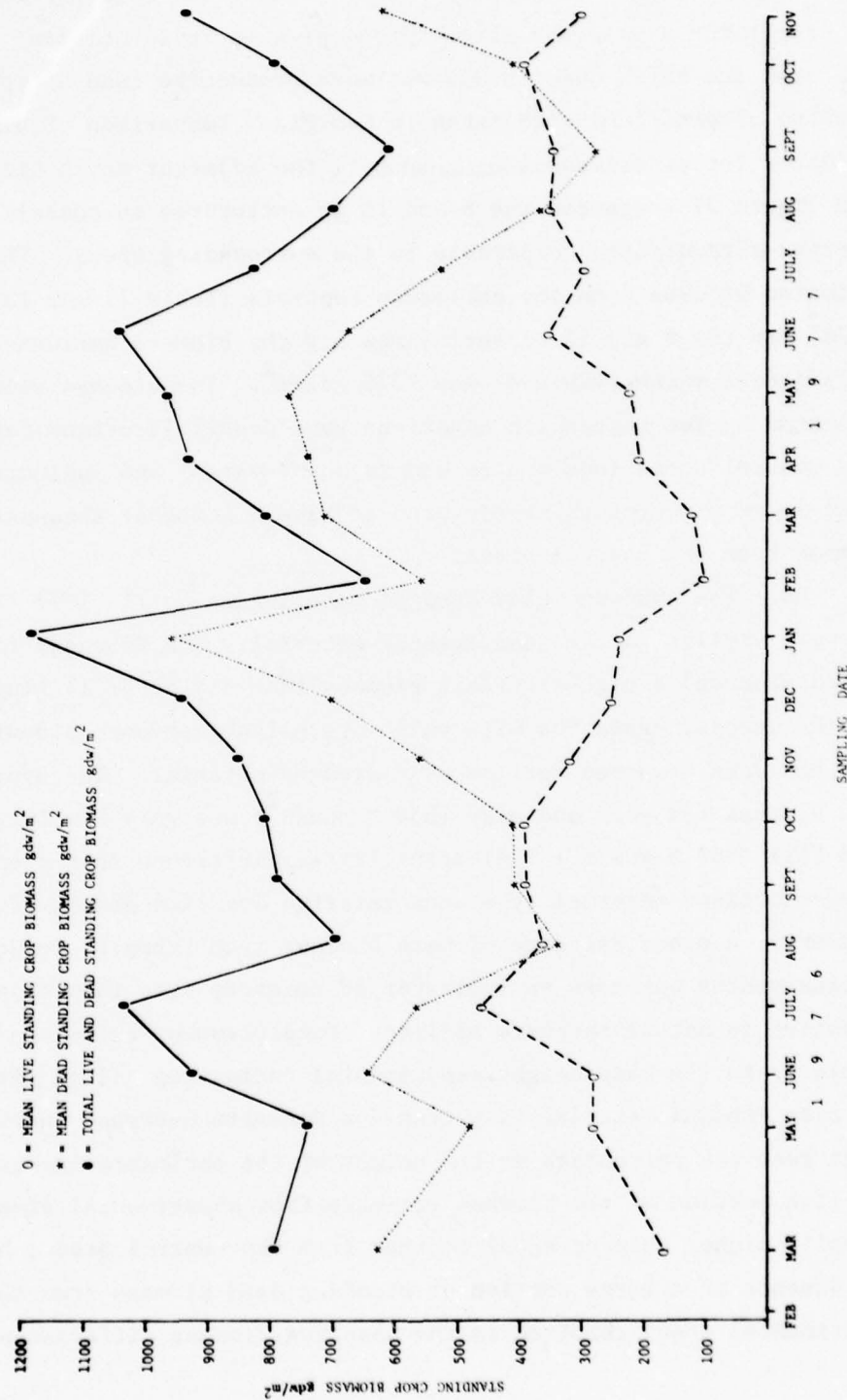


Figure 27. Live and dead standing crop biomass for *S. alterniflora* marshes adjacent to Marsh Smothering site.

biomass was higher than biomass values obtained by Gallagher et al. (in press) for a *Spartina alterniflora* high marsh in Georgia. This suggested the marsh under study was more productive than a typical *Spartina alterniflora* high marsh in Georgia. Comparison of biomass estimates for experimental enclosures to the adjacent marsh biomass from Figure 27 suggested the 8 and 15 cm enclosures to contain *Spartina alterniflora* comparable to the surrounding areas. The mean estimated biomass from the enclosure controls (Table 7) was 1316  $\text{gdw/m}^2$  for the 8 and 15 cm enclosures and the biomass estimated for the adjacent marsh (Table 8) was 1326  $\text{gdw/m}^2$ . The biomass values estimated by the regression equations were nearly identical for both type control areas (enclosures and adjacent marsh) and indicated the 8 and 15 cm experimental enclosures to have a somewhat attenuated biomass from the control areas.

66. The sand and clay dredged material in April 1977 (Table 9), was very similar to the sand dredged material. The February filling period produced a higher overall biomass than any other filling month but the general gradation with enclosure height was more stepwise than had been observed for the sand dredged material. The overall mean biomass for sand and clay (559.9  $\text{gdw/m}^2$ ) was very similar to the sand fill (567.5  $\text{gdw/m}^2$ ) indicating little difference in the effect of each dredged material type upon relative *Spartina alterniflora* recovery. A minor decrease of mean biomass from February to November filling months was more an indicator of recovery time than seasonal variation in actual recovery ability. Comparison of enclosure controls (Table 7) to the same height experimental enclosures filled with sand and clay dredged material illustrated a definite decrease in relative plant recovery percentage as the height of the enclosure increased. The live portion of the biomass estimate from experimental areas was normally higher than or equal to that from the control areas, however the absence of a large portion of standing dead biomass from the experimental areas resulted in the observed biomass differences.

TABLE 7

MARSH SMOTHERING CONTROL ENCLOSURESESTIMATED STANDING CROP BIOMASS AND CULM DENSITY FROM PERMANENT 0.05 m<sup>2</sup> QUADRATS

Depth of fill	<u>APRIL 1977</u>		<u>NOVEMBER 1977</u>	
	mean culm density /m <sup>2</sup>	mean standing crop biomass gdw/m <sup>2</sup>	mean culm density /m <sup>2</sup>	mean standing* crop biomass gdw/m <sup>2</sup>
8 cm.	310	1234.0	170	749.0
15 cm.	327	1397.3	313	953.3
23 cm.	500	1170.3	566	988.9
30 cm.	326	1410.5	356	1212.7
61 cm.	293	1313.8	340	1087.3
91 cm.	127	991.2	87	602.4

TABLE 8

## MARSH SMOTHERING ADJACENT MARSH CONTROLS

ESTIMATED STANDING CROP BIOMASS AND CULM DENSITY FROM 0.05 m<sup>2</sup> QUADRATS

Location	APRIL 1977		NOVEMBER 1977	
	mean culm density /m <sup>2</sup>	mean standing crop biomass gdw/m <sup>2</sup>	mean culm density /m <sup>2</sup>	mean standing crop biomass gdw/m <sup>2</sup>
East marsh	520	978.5	880	1112.0
North marsh	340	1429.4	450	1296.0
West marsh	360	1571.2	650	1833.9
East 3m x 3m Enclosures	440	1437.9	640	1488.4
West 3m x 3m Enclosures	670	1376.6	610	1228.5



TABLE 9  
MARSH SMOTHERING EXPERIMENTAL ENCLOSURES  
ESTIMATED COMBINED LIVE AND DEAD STANDING CROP BIOMASS  
AND CULM DENSITY FROM PERMANENT 0.05 m<sup>2</sup> QUADRATS

Substrate type :		APRIL 1977					
				JULY		NOVEMBER	
Month of filling:		FEBRUARY					
Depth of fill	mean culm density /m <sup>2</sup>	mean standing crop biomass gdw/m <sup>2</sup>	mean culm <sup>2</sup> density /m <sup>2</sup>	mean standing crop biomass gdw/m <sup>2</sup>	mean culm density /m <sup>2</sup>	mean standing crop biomass gdw/m <sup>2</sup>	mean standing crop biomass gdw/m <sup>2</sup>
8 cm.	340	960.4	340	800.7	460	1114.9	
15 cm.	213	600.9	193	577.4	300	421.7	
23 cm.	193	950.5	120	367.4	230	285.0	
30 cm.	100	242.2	67	162.6	120	234.8	

67. Experimental enclosures smothered with clay dredged material varied little in terms of overall mean biomass ( $528.9 \text{ gdw/m}^2$ ) from the two sandy dredged materials (Table 10). The 8 and 15 cm enclosures attained the highest biomass values for the clay dredged material for each of the three filling months. The 30 cm enclosures had a lower mean biomass for the clay dredged material than for the sandy dredged materials. The clay substrate consolidated and dried to a hard block covering the marsh, thus providing more resistance to rhizome penetration than the sandy dredged materials and reducing overall biomass. The mean biomass of the 8 and 15 cm enclosures for February filling was twice that of either the July or November filling. A similar trend was evident with the sandy dredged materials, but was not manifest to such a degree. The effect of time on plant biomass recovery was evident by the successive increases in combined live and dead plant biomass from the February through November fillings.

68. A comparison of the experimental enclosures to both the adjacent marsh controls and the enclosure controls showed the much lower overall biomass attained by the experimental areas. The 8 and 15 cm enclosures from the February filling of the clay substrate approached the biomass values estimated for both control areas.  
November 1977

69. The combined live and dead standing crop biomass of the adjacent *Spartina alterniflora* marshes in November was a peak period as had been the case for the April sampling (Figure 27). Consequently, the total standing crop biomass at the time of both sampling intervals was essentially identical (April,  $950.4 \text{ gdw/m}^2$  and November,  $948.1 \text{ gdw/m}^2$ ). Therefore changes of overall plant biomass from the April to November sampling in the experimental enclosures was attributed to the recovery process and not to natural seasonal fluctuations of the *Spartina alterniflora* standing crop biomass.

70. The November monitoring of the sand filled experimental enclosures (Table 11) revealed an overall mean biomass increase of

TABLE 10  
MARSH SMOTHERING EXPERIMENTAL ENCLOSURES  
ESTIMATED COMBINED LIVE AND DEAD STANDING CROP BIOMASS  
AND CULM DENSITY FROM PERMANENT 0.05 m<sup>2</sup> QUADRATS

APRIL 1977

Substrate type :		CLAY					
Month of filling:	Depth of fill	FEBRUARY		JULY		NOVEMBER	
		mean culm density /m <sup>2</sup>	mean standing* crop biomass gdw/m <sup>2</sup>	mean culm <sup>2</sup> density /m <sup>2</sup>	mean standing crop biomass gdw/m <sup>2</sup>	mean culm density /m <sup>2</sup>	mean standing crop biomass gdw/m <sup>2</sup>
	8 cm.	293	1052.6	173	507.2	320	725.7
	15 cm.	286	1216.3	190	570.0	120	305.5
	23 cm.	166	475.5	150	486.5	180	308.6
	30 cm.	126	476.7	66	165.0	30	57.0

TABLE 11  
MARSH SMOTHERING EXPERIMENTAL ENCLOSURES  
ESTIMATED COMBINED LIVE AND DEAD STANDING CROP BIOMASS  
AND CULM DENSITY FROM PERMANENT 0.05 m<sup>2</sup> QUADRATS

Substrate type :		NOVEMBER 1977					
		FEBRUARY			JULY		
Month of filling:		FEBRUARY		JULY		NOVEMBER	
Depth of fill	mean culm density /m <sup>2</sup>	mean standing crop biomass gdw/m <sup>2</sup>	mean culm density /m <sup>2</sup>	mean standing crop biomass gdw/m <sup>2</sup>	mean culm density /m <sup>2</sup>	mean standing crop biomass gdw/m <sup>2</sup>	mean culm density /m <sup>2</sup>
8 cm.	233	682.8	240	732.9	200	552.5	
15 cm.	260	781.0	240	661.5	230	820.6	
23 cm.	213	799.1	153	642.6	160	584.4	
30 cm.	153	609.3	270	1281.2	70	340.0	



139.8 gdw/m<sup>2</sup> over the April sampling period. The increase in biomass was the result of significant gains in biomass for the 23 and 30 cm enclosures for all filling dates. As a result of the increase in biomass, the February and July filling dates failed to manifest biomass differences by enclosure height less than 30 cm. This suggested that the *Spartina alterniflora* which had survived the 23 and 30 cm fillings was now as healthy as the *Spartina alterniflora* in the shallower fills. The enclosures filled in November made biomass gains of over 125 gdw/m<sup>2</sup> but biomass differentiation by enclosure height was still evident. The biomass means by filling month showed February and July to be similar with November still lagging in biomass. The mean biomass of the experimental enclosures was less than the control enclosures and the adjacent marsh controls suggesting full recovery had not yet taken place.

71. The November monitoring of the experimental enclosures filled with sand and clay dredged material was found in Table 12. The overall mean biomass increased from 559.9 gdw/m<sup>2</sup> in April to 805.8 gdw/m<sup>2</sup> in November. This substantial gain resulted from large biomass increases in the 23 and 30 cm enclosures. The mean biomass for each filling date was similar indicating an accelerated growth rate experienced by the July and November fills during the 1977 growing season. The mean biomass for each height of enclosures was no longer significantly different, as had been the case with the sand dredged material. Comparison of the experimental mean combined live and dead plant biomass to the enclosure controls yielded a 126.5 gdw/m<sup>2</sup> difference with the enclosure controls still slightly greater. The adjacent marsh controls mean biomass was substantially greater than the experimental enclosures. Overall the sand and clay dredged material had a higher mean biomass (805.8 gdw/m<sup>2</sup>) than did the sand dredged material (707.3 gdw/m<sup>2</sup>).

72. Evaluation of the clay substrate for the November interval (Table 13) showed another large overall mean biomass increase from the April sampling period. Most of the biomass increases occurred in the

TABLE 12  
MARSH SMOTHERING EXPERIMENTAL ENCLOSURES  
ESTIMATED COMBINED LIVE AND DEAD STANDING CROP BIOMASS  
AND CULM DENSITY FROM PERMANENT 0.05 m<sup>2</sup> QUADRATS

		NOVEMBER 1977					
Substrate type :		SAND AND CLAY					
Month of filling:	Depth of fill	FEBRUARY		JULY		NOVEMBER	
		mean culm density /m <sup>2</sup>	mean standing crop biomass gdw/m <sup>2</sup>	mean culm density /m <sup>2</sup>	mean standing crop biomass gdw/m <sup>2</sup>	mean culm density /m <sup>2</sup>	mean standing crop biomass gdw/m <sup>2</sup>
	8 cm.	266	870.8	200	557.4	320	792.8
	15 cm.	145	672.4	233	1271.3	190	407.7
	23 cm.	233	857.4	487	960.6	405	819.5
	30 cm.	340	981.5	110	518.4	230	960.0

TABLE 13

## MARSH SMOTHERING EXPERIMENTAL ENCLOSURES

## ESTIMATED COMBINED LIVE AND DEAD STANDING CROP BIOMASS

AND CULM DENSITY FROM PERMANENT 0.05 m<sup>2</sup> QUADRATS

		NOVEMBER 1977					
Substrate type :		CLAY					
Month of filling:		FEBRUARY		JULY		NOVEMBER	
Depth of fill	mean culm density /m <sup>2</sup>	mean standing crop biomass gdw/m <sup>2</sup>	mean culm density /m <sup>2</sup>	mean standing crop biomass gdw/m <sup>2</sup>	mean culm density /m <sup>2</sup>	mean standing crop biomass gdw/m <sup>2</sup>	mean culm density /m <sup>2</sup>
8 cm.	153	667.5	206	774.7	220	726.6	
15 cm.	240	877.5	260	849.7	230	953.0	
23 cm.	446	1176.5	286	1022.6	280	1046.2	
30 cm.	293	1142.6	193	826.8	160	644.0	

23 and 30 cm enclosures with many of the shallow fills decreasing in biomass. The differentiation of filling month by biomass was not as pronounced as had been, but the February fill still attained the greatest mean biomass. The mean overall biomass for the clay substrate ( $892.3 \text{ gdw/m}^2$ ) was the largest of the three dredged materials tested and was only  $40 \text{ gdw/m}^2$  less than the mean biomass for the enclosure controls. A significant gap still existed between the adjacent marsh controls and the clay substrate suggesting the experimental treatments had not attained a climax stage.

73. The enclosure controls (Table 7) decreased in mean overall biomass from  $1316 \text{ gdw/m}^2$  in April to  $932.3 \text{ gdw/m}^2$  in November. The major decreases were manifested in the shallow fills as was the case with the experimental enclosures. These trends indicated the possibility of a container effect beginning to develop. All heights of enclosure controls decreased in mean biomass indicating a factor common to all to be the cause. The adjacent marsh controls showed an increase in mean biomass and the  $3\text{m} \times 3\text{m}$  enclosures remained about the same (Table 8). The stability of the  $3\text{m} \times 3\text{m}$  enclosure control mean biomass, and the decrease of mean biomass experienced in the smaller enclosure controls, suggested the larger  $3\text{m} \times 3\text{m}$  enclosure controls were not subject to the container effect that the smaller enclosures demonstrated.

#### Biomass Models

74. Biomass estimates from April and November 1977 experimental and control areas were pooled and an analysis of variance performed. Enclosures exhibiting no plant recovery were treated as missing values rather than zero values. This maintained the actual biomass and culm density values of the remaining enclosures and provided an equitable comparator to the control areas. The treatments of height, soil and month were identical to those described for culm density. The treatment labeled control tested the potential difference between control



and experimental enclosures. The treatments of soil and month were not applicable to the control areas therefore were not included in treatment interactions involving the control treatment. Biomass and culm densities were calculated from stationary  $0.05\text{m}^2$  circular quadrats positioned in each experimental and control enclosure.

75. The significant treatments from the analysis of variance for biomass and culm density estimates (Appendix C) can be found in Table 14. Live biomass and live and dead culm density showed significantly different means among height treatments (Table 15). The live biomass for the 61 cm enclosures was significantly higher than any other enclosure, however, the vegetation measured was the result of naturally seeded *Spartina alterniflora* inhabiting the filled enclosures. This was not a response to the experimental treatment of height. The highest mean live biomass developed in the 8, 15, and 23 cm enclosure heights. The 8 and 15 cm live biomass means were slightly less than the  $685\text{ gdw/m}^2$  mean for the adjacent marsh. The difference between the experimental and adjacent marsh mean live biomass was within the limits of sampling error and indicated recovery had progressed to near normal biomass levels. The 30 and 91 cm enclosures were only about half of the adjacent marsh live biomass, however the 91 cm enclosures measured 3 occurrences of a few culms protruding the dredged material along the edge of the enclosure and one area exhibiting natural seeding. Neither response was a true indicator of recovery from the 91 cm filling operation.

76. Live culm densities (Table 15) described the 8, 15 and 23 cm enclosures to be significantly greater than the 30 cm enclosures. This relationship was consistent with the culm densities enumerated in Part III. The 61 and 91 cm enclosures were not discussed since the response was not a true indicator of recovery (see previous paragraph). The 30 cm enclosures had a significantly higher mean dead culm density than the 8 or 15 cm enclosures. The greater density of standing dead culms indicated the 30 cm enclosures failed to receive frequent tidal

TABLE 14

Significance of Treatments from  
the Analysis of Variance for Biomass Measurements  
in the Marsh Smothering Enclosures

TREATMENT	Dead Biomass gdw/m <sup>2</sup>	Live Biomass gdw/m <sup>2</sup>	Total Biomass gdw/m <sup>2</sup>	Live Culms /m <sup>2</sup>	Dead Culms /m <sup>2</sup>
Height	NS	*	NS	****	**
Soil	NS	**	**	**	NS
Height x Soil	NS	NS	NS	**	NS
Month	***	NS	**	NS	**
Height x Month	NS	NS	NS	NS	NS
Soil x Month	NS	NS	NS	NS	NS
Height x Soil x Month	NS	NS	NS	NS	NS
Control	****	****	****	****	****
Height x Control	NS	NS	NS	**	NS

Probability level: NS = not significant \* = 0.05 \*\* = 0.01

\*\*\* = 0.001 \*\*\*\* = 0.0001.

TABLE 15

Biomass and Culm Density Means for  
Marsh Smothering Enclosures

HEIGHT (cm)	Dead Biomass gdw/m <sup>2</sup>	Live Biomass gdw/m <sup>2</sup>	Total Biomass gdw/m <sup>2</sup>	Dead Culms /m <sup>2</sup>	Live Culms /m <sup>2</sup>
8	149.2 b	625.1 b	774.3 b	89.1 b	264.8 a
15	140.3 b	616.0 b	756.4 b	94.8 b	242.8 a
23	184.1 ab	523.4 b	707.6 bc	149.4 ab	263.0 a
30	199.9 ab	390.1 c	590.0 c	157.6 a	175.5 b
61	295.0 ab	904.9 a	1199.9 a	150.0 ab	316.6 a
91	310.8 a	371.0 c	681.9 c	128.5 ab	108.5 b

Means followed by similar letters were not significantly different at  $p = 0.05$  according to Duncan's Multiple Range test.

inundation necessary to remove the dead portions. The 23 cm enclosures had the second highest dead culm density which was approximately 40% higher than the 8 and 15 cm enclosures. The 61 and 91 cm enclosures exhibited high dead culm densities for the limited vegetation found in those enclosures.

77. The treatment of soil type exhibited significant mean differences for live and total biomass and live culm density (Table 14). Table 16 showed the clay substrate to support a significantly greater live and total biomass than either the sand or sand and clay dredged materials. The differentiation between dredged material types was not as pronounced for live culm density as had been for biomass. The clay dredged material had a significantly higher live stem density than the sand dredged material. The actual difference in live culm densities among the dredged material types ranged from 210-252 culms/m<sup>2</sup> illustrating small differences which may only require more recovery time to equilibrate. This was much the same trend described by the culm density model in Part IV. After consolidation the clay dredged material afforded the greatest physical barrier to rhizome spread, however after establishment of a few shoots from the underlying marsh, tiller production from these shoots was much faster and denser in the clay dredged material than in the sandy dredged materials.

78. The interaction of the height x soil treatments demonstrated significant mean difference for live culm density. The remaining measurements of the plant population failed to reach the significance criterion. The lowest live culm densities were associated with the two sandy dredged materials in the 91 cm enclosures.

79. The next treatment, month of filling, produced significant mean differences for dead biomass, total biomass, and dead culm density (Table 14). Dead and total biomass means were significantly lower for the July filling, (Table 16). Dead culm density was also significantly lower for the July filling. Live biomass and live culm density means although not significant were lowest for the July filling. This trend



TABLE 16

Biomass and Culm Density Means by  
Soil Type, Month of Smothering and Enclosure Type

SOIL TYPE	Dead Biomass gdw/m <sup>2</sup>	Live Biomass gdw/m <sup>2</sup>	Total Biomass gdw/m <sup>2</sup>	Live Culm /m <sup>2</sup>	Dead Culm /m <sup>2</sup>
Sand	187 a	494 b	680 b	210 b	134 a
Sand and Clay	160 a	514 b	674 b	245 ab	120 a
Clay	184 a	624 a	808 a	252 a	134 a
-----					
MONTH					
February	206 a	555 a	761 a	241 a	128 a
July	102 b	501 a	603 b	199 b	73 b
November	214 a	564 a	779 a	261 a	152 a
-----					
ENCLOSURE TYPE					
Control areas	354 a	714 a	1068 a	319 a	187 a
Experimental areas	142 b	508 b	650 b	219 b	104 b

Means followed by similar letters were not significantly different at  
 $p = 0.05$  according to Duncan's Multiple Range test.

indicated the midgrowing season filling operation (July) recovered slower than beginning or end of season smothering operations. The lack of a significant difference for live biomass suggested the July filling was presently equaling the production rate of the other months and the absence of previous growth (dead material) was contributing to the significant differences. This indicated the July filling operation needed a longer recovery interval.

80. The treatment termed control provided a comparison of experimental enclosures (filled) and control enclosures and yielded significant differences for all parameters measured (Table 14). In all cases the means for the control enclosures were significantly higher than the experimental enclosures (Table 16). The experimental enclosures contained approximately 40 percent less biomass and 33 percent less live culms than did the control enclosures.

81. The interaction of the height x control treatments demonstrated significant differences for live culm densities (Table 14). The similarity of experimental and control enclosures in terms of biomass for each height indicated the potential for vegetation to recover to near normal densities after the smothering operation.

#### Summary

82. The estimated biomass measurements for the experimental and control enclosures revealed differences in biomass were related to smothering depth, dredged material type and month of smothering. The largest mean biomass differences resulted from the depth of smothering. Immediately after smothering, the number of culms and rhizomes able to grow through the dredged material was small. The two sandy dredged materials allowed a higher density of culms to emerge than did the clay dredged material. This density trend continued, however, in terms of biomass the clay dredged material produced higher combined live and dead biomass than did either of the sandy dredged

materials. The more luxuriant growth of *Spartina alterniflora* in the clay dredged material probably was the result of added nutrient from the dredged material. The gradation of biomass production versus depth of dredged material showed 8, 15 and 23 cm enclosure heights to have highest biomass production. The 30 cm enclosures produced significantly less biomass and the 61 and 91 cm enclosure biomass values were the result of naturally seeded *Spartina alterniflora* and therefore not a true indicator of recovery from a smothering operation.

83. Biomass differences related to dredged material type described the clay dredged material to have the highest biomass production with two sandy dredged materials not far behind. The sand dredged material and clay dredged material yielded similar biomass values for dead material with the sand and clay material producing slightly less dead biomass. The lower dead biomass in the sand and clay dredged material suggested attenuated biomass production following the smothering operation as compared to the other two dredged materials.

84. The July filling period yielded significantly less combined biomass than either the February or November filling months. Lower dead biomass values for the July filling indicated the lower overall biomass resulted from less growth the previous year since the standing dead would be an indicator of the previous years growth.

85. Overall biomass increases from April 1977 to November 1977 resulted from substantial increases in the 23 and 30 cm inclosures. The 8 and 15 cm enclosures for all dredged materials maintained lower biomass values than the enclosures controls and adjacent marsh controls. By November 1977, the 8, 15, 23 and 30 cm enclosures contained similar biomass values, however, levels were still lower than control areas.

86. A comparison of adjacent marsh and enclosure control areas revealed the enclosure controls to have an attenuated mean biomass from that of the adjacent marsh areas. In April 1977 the two control types were similar but in November 1977 the control enclosures lacked the recruitment (culm density) and biomass levels of the adjacent

*Spartina alterniflora* marsh. The disparity between the two control types indicated a possible container effect was beginning in the enclosures. Restriction of tidal inundation, interstitial water movement or incident sunlight were factors associated with the enclosures which may have attributed to the attenuated culm density and biomass in the enclosure controls. The filled enclosures of 8 and 15 cm approximated the biomass and density values of the enclosure controls suggesting the filled enclosures had attained full recovery within the experimental restraints of the enclosures. Biomass estimates using the regression equations for the adjacent marsh were higher than estimates by destructive techniques.



## PART V: DREDGED MATERIAL CHEMISTRY

87. The dredged material types were selected to typify the sediments encountered while dredging in the southeast. The sandy dredged materials were indicative of a freshwater delta system or a beach and shoal system. The clay dredged material would better typify the sediments of a tidal marshland system. All three dredged materials were dredged from waterways in the Brunswick, Georgia area.

88. Table 17 describes the particle size distribution of the dredged substrates. The sand and sand and clay dredged materials were similar except for a larger portion of organic material and a higher percentage of silt particles (Gallagher et al. 1977). The sand and clay substrate frequently contained lumps of clay material mixed with the sand. The clay dredged material contained many *Spartina alterniflora* roots and small shells described by the fraction labeled granule. The major portion of the very coarse sand and coarse sand fractions for the clay dredged material contained shell fragments and pieces of root material.

89. Prior to initiation of the filling operation, cores 7.3 cm in diameter and 60 cm deep were taken from the *Spartina alterniflora* marsh adjacent to the proposed study area. Chemical and physical properties of the soil were determined to establish baseline conditions (Tables 18 and 19). Also depicted on the tables was a similar analysis of each of the dredged material types. Of the three dredged materials, the sand materials were poorest in nutrient content as well as cation exchange capacity. The sand and clay dredged material varied somewhat from the sand material in that nutrient levels were generally higher (especially iron and calcium) and the cation exchange capacity was also slightly higher. Neither of the sandy dredged materials resembled the chemical soil properties existing in the *Spartina alterniflora* marsh before the filling operation. The clay substrate was similar to the marsh soil. The comparable nutrient levels as well as cation

TABLE 17  
DREDGED MATERIAL SIEVE ANALYSIS  
MARSH SMOTHERING EXPERIMENTAL ENCLOSURES

FEBRUARY 1976

PARTICLE SIZE	DESCRIPTION OF FRACTION*	SILTY SAND	SAND	CLAY
GRAINS < 2mm	GRANULE	0.5%	0.1%	21.7%
GRAINS > 1mm < 2mm	VERY COARSE SAND	6.8%	4.6%	12.2%
GRAINS > 500 $\mu$ < 1mm	COARSE SAND	43.9%	45.1%	13.0%
GRAINS < 500 $\mu$	MEDIUM SAND AND SMALLER	48.8%	50.2%	53.1%

\* from Buchanan and Kain 1971.

TABLE 18  
PHYSICAL ANALYSIS OF MARSH CONTROLS AND DREDGED MATERIAL SUBSTRATES FOR  
MARSH SMOTHERING SITE

FEBRUARY 1976

Substrate type:	Depth of core (cm.)	pH <sup>w</sup>	Eh (mv.)	% H <sub>2</sub> O	CEC meg/100g.	% O.M.
East marsh	0-15	7.5	+ 319	30.0	19.27	2.56
East marsh	15-30	7.4	+ 104	55.0	29.08	9.90
East marsh	30-45	7.7	+ 144	62.0	—	13.47
East marsh	45-60	7.6	+ 194	46.0	33.42	6.29
North marsh	0-15	7.7	+ 239	58.0	28.67	13.06
North marsh	15-30	7.7	+ 134	64.0	22.47	13.56
North marsh	30-45	7.9	+ 299	63.0	33.14	13.37
North marsh	45-60	7.8	+ 284	51.0	34.83	8.22
West marsh	0-15	7.9	+ 124	60.0	29.55	13.54
West marsh	15-30	8.0	+ 294	64.0	24.12	15.55
West marsh	30-45	8.0	+ 184	33.0	33.41	4.06
West marsh	45-60	8.2	+ 284	10.0	28.99	1.10
Silty sand	surface	7.8	+ 408	6.0	1.90	—
Clay	surface	7.2	+ 182	51.0	30.20	—
Sand	surface	6.9	+ 406	17.8	0.59	—

pH<sup>w</sup> = 1:1 parts distilled water to soil by weight; Eh (mv.) = Redox potential in millivolts;  
 % H<sub>2</sub>O = percent water content; CEC = Cation exchange capacity in milliequivalents per 100  
 grams dry weight of soil sample; % O.M. = percent organic matter.

TABLE 19

## MINERAL ANALYSIS OF MARSH CONTROLS AND DREDGED MATERIAL SUBSTRATES FOR MARSH SMOTHERING SITE

FEBRUARY 1976

Substrate type:	Depth of core (cm.)	Fe*	Cu	K	Ca	Mg	Mn	B	S	Co	As	Zn
East marsh	0-15	9.1	0.0	265.0	2980.0	395	10.25	4.10	0.18	1.35	0.90	12.50
East marsh	15-30	0.1	0.0	299.0	4815.0	460	6.70	6.00	0.47	1A	1A	0.25
East marsh	30-45	305.0	0.3	787.5	4460.0	1620	23.75	10.75	0.70	1A	1A	3.60
East marsh	45-60	369.5	0.6	582.5	3145.0	1800	35.00	15.25	0.44	2.40	1.80	2.60
North marsh	0-15	366.0	1.4	890.0	2047.5	1650	17.65	8.75	0.37	1A	1A	7.20
North marsh	15-30	130.0	0.0	982.5	2232.5	670	22.30	13.65	0.48	1A	1A	64.50
North marsh	30-45	151.5	0.0	760.0	2137.5	1740	31.25	9.85	0.62	4.50	1A	6.45
North marsh	45-60	490.5	0.8	198.5	3820.0	1635	68.00	4.25	0.20	1.50	1.30	2.00
West marsh	0-15	610.5	0.7	942.5	2010.0	1810	49.70	12.60	0.51	5.50	5.00	5.70
West marsh	15-30	173.0	0.0	760.0	2247.5	880	12.75	13.10	0.68	1A	1A	5.80
West marsh	30-45	75.5	0.0	425.0	4865.0	815	22.40	6.90	0.34	3.10	1.60	23.00
West marsh	45-60	72.0	0.0	128.0	4980.0	355	11.25	2.20	0.05	1.25	0.70	10.50
Sand & clay	surface	443.5	0.0	21.5	300.0	44	0.00	0.10	0.01	1.25	0.06	17.00
Clay	surface	40.75	0.0	421.5	4375.0	725	36.20	7.50	0.31	2.25	2.85	2.90
Sand	surface	41.67	0.4	8.6	64.3	21	5.25	0.12	0.01	1A	1A	1A

\* All values in parts per million. Fe= iron; Cu= copper; K= potassium; Ca= calcium; Mg= magnesium; Mn= manganese; B= boron  
 S= sulfur; Co= cobalt; As= arsenic; Zn= zinc; 1A= insufficient amount of sample for analysis.



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GEORGIA UNIV BRUNSWICK MARINE EXTENSION SERVICE

F/G 13/2

THE EFFECTS OF SMOTHERING A 'SPARTINA ALTERNIFLORA' SALT MARSH --ETC(U)

JUL 78 R J REIMOLD, M A HARDISKY, P C ADAMS

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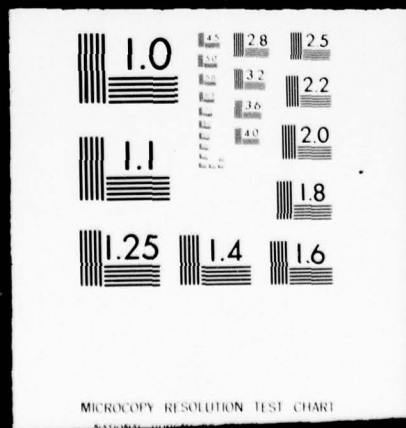
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exchange capacity indicated that areas smothered with the clay substrate might have a distinct survival advantage over those areas smothered with the sandy dredged material. This hypothesis was substantiated in terms of biomass production in Part IV.

90. During the experimental period, dredged material analysis consisted of monitoring changes in the physical properties of the substrate. Following the filling operation, the sandy dredged materials showed some consolidation and drying of the surface layers but overall maintained a texture analogous to that of the filling period (Table 2). The moisture content of the clay was greater than 50% during the filling operation. As the clay dried, it consolidated into a dense block with numerous cracks left by the contact of the dredged material. In many instances the large cracks in the dried clay afforded the only opportunity for smothered vegetation to gain access to the surface.

91. Other physical properties of the dredged materials included the soil salinity and moisture content. Table 20 described salinity and percent water measurements of the various dredged materials five months after filling for the February filling and several weeks following the July filling. The two sandy dredged materials changed little in either salinity or moisture with time. A slight decrease in redox potential was observed with time. The clay dredged material experienced a 39% reduction in water content and a 28% reduction soil salinity during the 5 months after filling. An increase in the redox potential for the clay substrate over 5 months was observed.

92. Table 21 depicted soil moisture, salinity and temperature at the beginning of the 1977 growing season for the experimental enclosures as well as a variety of *Spartina alterniflora* marsh types by height class adjacent to the study area. Each measurement was averaged over the 8 through 30 cm enclosure heights. The experimental enclosures soil salinity fell within the limits delineated by the various types of *Spartina alterniflora* marsh however, salinities

TABLE 20

PHYSICAL PROPERTIES OF THE THREE DREDGED MATERIALS USED  
IN THE MARSH SMOTHERING PROJECT

JULY 1976

DREDGED MATERIAL TYPE	DATE OF FILLING	REDOX POTENTIAL (mv)	SALINITY* 0/00	SALINITY † OF SOIL 0/00	% WATER
SAND	FEBRUARY	+380	3	17	6
SILTY SAND	FEBRUARY	+350	8	29	11
CLAY	FEBRUARY	+350	29	52	27
SAND	JULY	+480	5	27	4
SILTY SAND	JULY	+500	6	20	9
CLAY	JULY	+280	67	72	44

All values are averages of the six depth of fill. \* A 1 part water:  
1 part dry soil mixture. † Salinity of in situ soil calculated from  
the 1:1 mixture.



TABLE 21

MARSH SMOTHERING SOIL MOISTURE, SALINITY, AND TEMPERATURE

APRIL 1977

Location Description (control areas)	Soil Temperature °C (surface)	Moisture Content (percent)	Salinity (‰)
70 cm <i>Spartina alterniflora</i>	31.0	62.2	13
50 cm <i>Spartina alterniflora</i>	28.0	56.3	35
30 cm <i>Spartina alterniflora</i>	29.5	32.9	28
10-15 cm <i>Spartina alterniflora</i> & <i>Salicornia virginica</i>	35.0	27.6	54
- - - - -			
<u>Experimental Areas</u>			
February filling:			
Sand	24.0	10.0	42
Sand and Clay	30.0	15.3	49
Clay	30.5	31.5	50
July Filling:			
Sand	31.0	10.5	36
Sand and Clay	29.0	14.0	35
Clay	30.0	37.2	20
November filling:			
Sand	30.0	14.2	48
Sand and Clay	32.0	16.2	36
Clay	26.0	45.7	47

tended to be higher in the experimental areas. It was important to monitor salinity levels since smaller height forms of *Spartina alterniflora* may evolve from the experimental enclosures with high soil salinities. This would affect comparisons of control and experiments areas by biomass or culm density estimates. With the exception of the clay dredged material, the soil moisture levels of the experimental enclosures was much lower than that of the surrounding marshes. This was the result of the higher elevation of the filled enclosures. The soil temperature was quite variable from area to area. The experimental enclosures had two areas with lower surface soil temperatures than the surrounding marshes. The similarity of soil temperatures for adjacent marsh and experimental enclosures suggested that soil temperature was not a factor altering *Spartina alterniflora* response. Soil salinity and temperature for the experimental enclosures fell within the limits of the adjacent *Spartina alterniflora* marshes suggesting there was no detrimental effect upon the surviving vegetation.

93. Available nitrogen and phosphorus in the three dredged materials changed with time after deposition (Table 22). Analyses performed in July 1976 for each of the dredged material types revealed decreased concentrations with time of all nutrients tested for the sand dredged material (February 1976) as compared to the more recent deposition in July 1976. The sand and clay substrate maintained consistent nitrogen levels from February to July 1976. The clay dredged material exhibited reduced concentrations of ammonia nitrogen and orthophosphate and an increase in nitrate and nitrate nitrogen concentrations. The December 1976 sampling period showed decreased nitrate and nitrite nitrogen and orthophosphate concentrations for all dredged material types deposited in February 1976 (Table 22). Ammonia concentrations increased for the two sandy dredged materials and decreased for the clay dredged material over the same interval. Increased ammonia concentrations indicated the initiation of microbial activity in the sandy materials. In December

TABLE 22

Available Nitrogen and Phosphorus of Three Types of Dredged Material  
Used in Marsh Smothering Enclosures

Sampling Date	Time of Deposition	Type of Dredged Material	Ammonia-N ppm	Nitrate & Nitrite-N ppm	Orthophosphate ppm
July 1976	February 1976	Sand	0.0	0.3	8.7
		Sand and Clay	0.0	0.1	22.3
		Clay	68.0	1.7	13.7
July 1976	July 1976	Sand	1.6	0.4	10.7
		Sand and Clay	0.0	0.1	17.3
		Clay	90.5	0.6	19.0
December 1976	February 1976	Sand	2.7	0.1	2.2
		Sand and Clay	5.2	0.0	5.9
		Clay	25.5	0.4	13.6
December 1976	July 1976	Sand	3.2	0.1	2.4
		Sand and Clay	8.1	0.1	8.7
		Clay	27.4	0.5	20.6
December 1976	November 1976	Sand	1.6	0.0	2.0
		Sand and Clay	3.7	0.0	5.0
		Clay	20.0	0.0	29.7
December 1976		Adjacent Marsh	22.0	0.1	3.4

All samples were taken from a depth of 0 - 3 cm.

1976 the three dredged materials deposited in July 1976 had slightly higher nutrient concentrations than their respective counterparts from the February 1976 filling. The December 1976 monitoring of the November 1976 filling yielded lower concentrations for the sandy dredged materials than either of the previous filling dates for the same materials. The November 1976 filling of the clay dredged material found lower levels of ammonia and higher levels of orthophosphate than was determined for the previous deposition dates.

94. Ammonia nitrogen concentrations in the clay dredged material remained similar to those recorded for adjacent marsh areas. Orthophosphate levels were higher in the clay material than for adjacent marsh areas. The sandy dredged materials had attenuated concentration of ammonia nitrogen, similar levels of nitrate and nitrite nitrogen and slightly higher levels of orthophosphate as compared to the adjacent marsh areas. Overall the clay dredged material contained the highest levels of all available nutrients, the sand and clay dredged material was second, and the sand dredged material was poorest in available nutrients. Generally orthophosphate levels in the dredged materials were in excess to those of the adjacent marsh.

95. In November 1977, composite soil samples representing three heights of filled enclosures were collected from each dredged material type to determine changes in the physical and chemical properties of dredged materials with time (Tables 23 and 24). The cation exchange capacity increased for all dredged material types over the experimental period (Table 23). Cation exchange capacity values for the clay dredged material were similar to the control and adjacent marsh but the sandy dredged materials remained much lower than the control areas. Nitrate and nitrite nitrogen concentrations were lower for 8 through 23 cm sand dredged material, clay dredged material and the control enclosures than for the adjacent marsh. The 30 through 91 cm control areas yielded higher ammonia levels than the adjacent marsh. The remaining experimental enclosures had ammonia



TABLE 23  
CHEMICAL ANALYSIS OF COMPOSITE CORES TAKEN IN THE MARSH SMOOTHERING ENCLOSURES

NOVEMBER 1977

HEIGHT OF ENCLOSURES	SUBSTRATE TYPE	pH <sup>w</sup>	% H <sub>2</sub> O	CEC meg/100 g.	% O.M.	TOTAL N mg/g	NO <sub>2</sub> μg/g	NH <sub>3</sub> μg/g	TOTAL P mg/g	PO <sub>4</sub> μg/g
8cm -23cm	sand	6.3	17	6.46	0.6	2.99	3.58	0.32	0.51	37.40
30cm -91cm	sand	6.2	3	3.84	0.3	1.52	25.68	0.36	0.16	104.40
8cm -23cm	sand & clay	5.8	19	6.98	0.8	2.03	30.05	0.43	0.12	693.60
30cm -91cm	sand & clay	6.1	8	9.16	0.3	33.77	28.51	2.26	1.05	644.10
8cm -23cm	clay	6.1	48	90.75	10.8	3.98	12.50	0.18	0.30	568.20
30cm -91cm	clay	5.8	30	59.61	7.8	3.45	3.13	0.16	0.24	644.70
8cm -23cm	control	6.2	47	87.84	8.3	5.90	9.52	0.26	1.02	722.90
30cm -91cm	control	5.5	58	115.00	12.0	12.80	8.54	5.31	1.35	710.68
	adjacent marsh	5.9	54	82.51	11.3	11.90	24.07	0.37	2.83	864.64

Height of enclosures= number of cm. above marsh surface; Substrate type= description of dredged materials used; pH<sup>w</sup>= pH of 1:1 distilled water to soil mixture; % water= percent water content; CEC meg/100g.= Cation Exchange Capacity in milliequivalents per 100g dry weight of soil; % O.M.= Percent organic matter by weight; Total N mg/g= Total Kjeldahl Nitrogen in milligram per gram dry weight of soil; NO<sub>2</sub> μg/g= Nitrate and Nitrite Nitrogen in micrograms per gram dry weight of soil; NH<sub>3</sub> μg/g= Ammonia-nitrogen in micrograms per gram dry weight of soil; TOTAL P mg/g= Total phosphorous in milligrams per gram dry weight of soil; PO<sub>4</sub> μg/g= Orthophosphate in micrograms per gram dry weight of soil.

TABLE 24  
MINERAL CONTENT OF COMPOSITE CORES TAKEN IN THE MARSH SMOTHERING ENCLOSURES

NOVEMBER 1977

HEIGHT OF ENCLOSURES	SUBSTRATE TYPE	Fe ppm	Cu ppm	P ppm	K ppm	Ca ppm	Mg ppm	Mn ppm	B ppm	S ppm	Co ppm	As ppm
8cm -23cm	sand	72.5	0.09	10.0	70.5	146.5	146.5	8.5	0.935	35.5	<5	0.33
30cm -91cm	sand	31.0	0.08	6.0	31.5	83.0	52.5	23.5	0.075	10.5	<5	0.56
8cm -23cm	sand & clay	127.5	0.80	20.0	110.0	241.5	195.5	31.5	0.525	71.5	<5	0.30
30cm -91cm	sand & clay	60.0	1.35	24.0	23.0	85.0	55.5	3.5	0.125	17.0	<5	0.11
8cm -23cm	clay	275.0	0.25	0.5	652.5	5125.0	1537.5	58.5	7.150	1315.0	10	4.87
30cm -91cm	clay	42.5	1.60	12.0	305.0	5100.0	605.0	47.5	2.980	2387.0	8	5.04
8cm -23cm	control	762.5	0.40	172.0	637.5	2737.5	1562.5	17.0	8.220	IA	8	4.61
30cm -91cm	control	825.0	0.20	112.0	565.0	565.0	1312.5	22.5	6.850	IA	10	5.56
	adjacent marsh	1125.0	0.50	40.0	40.0	842.5	2425.0	27.5	8.580	IA	10	5.57

Fe ppm= Iron mg/l; Cu ppm= Copper mg/l; P ppm= Phosphorus mg/l; K ppm= Potassium mg/l; Ca ppm= Calcium mg/l; Mg ppm= Magnesium mg/l; Mn ppm= Manganese mg/l; B ppm= Boron mg/l; S ppm= Sulfur mg/l; Co ppm= Cobalt mg/l; As ppm= Arsenic mg/l.

concentrations near those of the adjacent marsh. Orthophosphate concentrations were similar to the adjacent marsh for all dredged material types and control areas except for the sand dredged material which had much lower concentrations. Total nitrogen and phosphorus concentrations were generally lower for the experimental areas as compared to the adjacent *Spartina alterniflora* marsh.

96. Table 24 depicts mineral nutrient concentrations of the experimental and control areas. The control enclosures had iron concentrations less than the adjacent marsh and the filled dredged materials revealed much lower iron concentrations than the adjacent marsh. Iron concentrations in the experimental enclosures were higher for 8 through 23 cm enclosures than for the 30 through 91 cm enclosures. Potassium, magnesium and manganese concentration levels increased in all dredged materials over the interval of February 1976 to November 1977. Each of the dredged materials exhibited an increased total sulfur concentration from the February 1976 monitoring with the clay dredged material having a 1000 fold increase. Oxidation of the clay dredged material may have initiated chemical transformations associated with cat-clay formation and account for the increased sulfur levels.

97. Nutrients levels increased for each dredged material faster in the 8 through 23 cm enclosures than for the 30 through 91 cm enclosures. This was the result of more frequent tidal inundation of the shallower enclosures. Silt and organic particle accumulation and growth of a microbial community fostered the more rapid increase in nutrient levels within the inundated areas. Although each dredged material made significant increases in nutrient levels, the concentrations remained less than the surrounding *Spartina alterniflora* marsh soil. The clay dredged material continued to resemble the adjacent marsh soil in chemical and nutrient composition.

98. Initially the clay dredged material was the only dredged material type to possess nutrient levels comparable to adjacent

marsh areas. Low available nitrogen and phosphorus levels in the sandy dredged materials increased from 1976 to 1977. Until 1977 the nitrogen concentrations (ammonia and nitrate-nitrite) were lower and phosphorus concentrations (Orthophosphate) were higher in the sandy dredged materials than in adjacent marsh controls. The sand dredged material exhibited the least improvement in soil nutrient concentrations of the three dredged materials. Soil salinity was higher in experimental enclosures than in adjacent marsh areas. However the salinity levels were within the limits determined for a number of adjacent *Spartina alterniflora* marsh types. The low nutrient concentrations and higher salinity levels of the experimental enclosures were not evident when considering culm densities and biomass production from Part IV. A production advantage was noted for the clay dredged material which may be related to a more normal soil nutrient environment.



## PART VI: PLANT INVASION OF EXPERIMENTAL ENCLOSURES

99. During regular monthly sampling periods any plant species other than *Spartina alterniflora* were recorded to document volunteer species. The various elevational regimes represented by the different depths of dredged material as well as the differences in physical properties of the dredged materials attracted a variety of marsh, transition, and upland species. Changes in the physical properties of the soil (Part V) in terms of salinity and pH also contributed to the diversification of habitat for attracting new species. Invading species propagation and dispersion was accomplished via windborne seeds, seeds desposited via the fecal material of birds, via waterborne seeds and via seeds deposited with the dredged material.

100. The higher elevation of the filled enclosures appeared to be the single most important factor in the survival of the invading species (Figure 28). Table 25 depicts the cumulative species composition list for the marsh smothering area. The code numbers in the invading species two-way frequency tables (Appendix D) corresponded to the species from Table 25 which occurred in the marsh smothering enclosures. Data collected over the entire two year period was pooled for the analysis. Since no invasion occurred in the control enclosures, they were not included in the analysis.

### Invading Plant Species by Enclosure Height

101. The table of invading frequency (Appendix D) segmented the invading population by enclosure height. The most numerous invading species and the percent of experimental enclosures inhabited were as follows: *Baccharis halimifolia* (2.1%), *Phytolacca americana* (1.0%), *Digitaria sanguinalis* (0.9%), *Solidago sempervirens* (0.9%), *Salicornia virginica* (0.6%), and *Cynodon dactylon* (0.5%). Percent invasion pressure by filling depth was 8 cm (0.6%), 15 cm (1.2%),

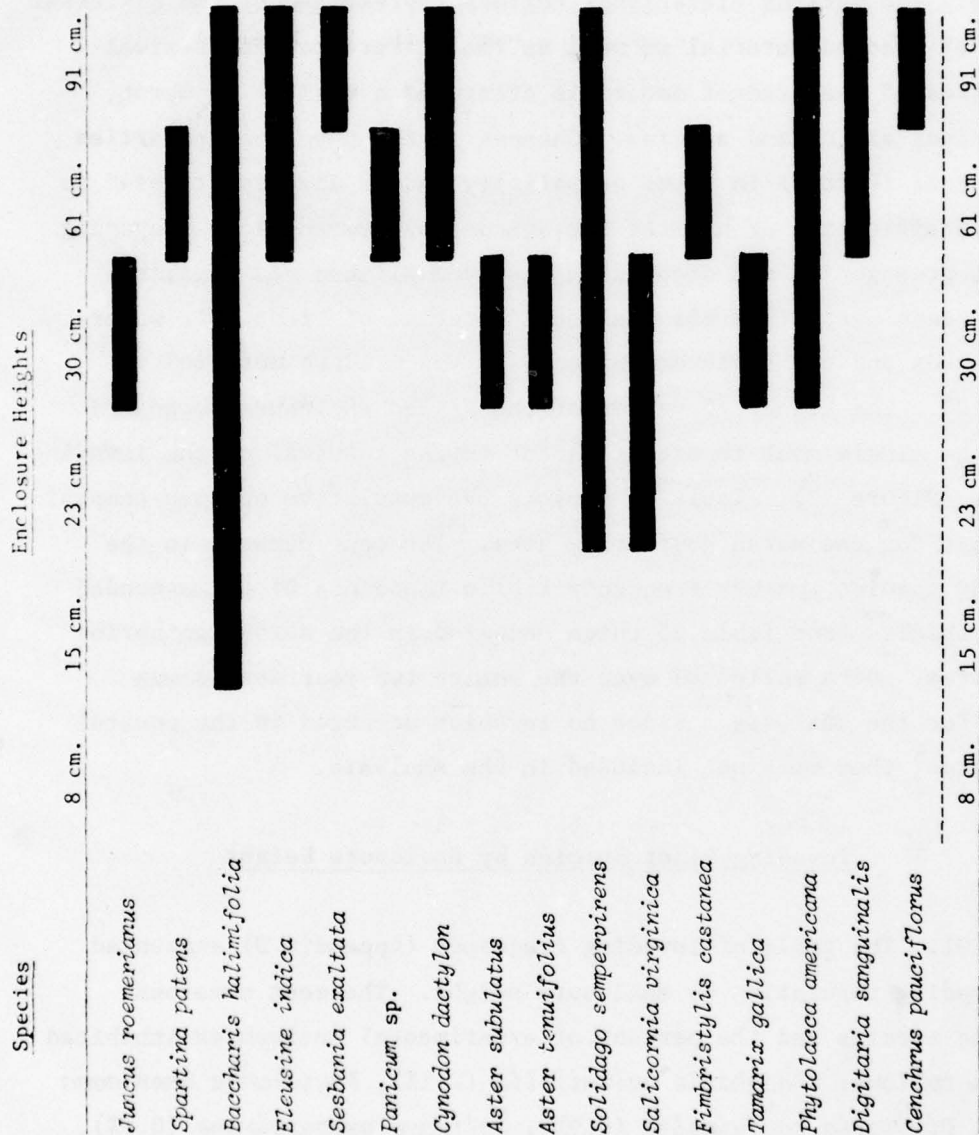


Figure 28. Occurrence of invading plant species within Marsh Smothering experimental enclosures.

Table 25  
Cumulative Species Composition List for Marsh  
Smothering Experimental Enclosures  
November 1976 - November 1977

Code Number	Scientific Names	Common Name
01	Unknown Species (Indicates Invader Was Present)	
05	<i>Juncus roemerianus</i> Scheel	Rush
08	<i>Spartina patens</i> (Ait.) Muhl.	Salt-Meadow
10	<i>Baccharis halimifolia</i> L.	Sea-Myrtle
13	<i>Eleusine indica</i> (L.) Gaern.	Goose-Grass
24	<i>Sesbania exaltata</i> (Raf.) Cory	Coffee-Bean weed
25	<i>Panicum</i> sp. L.	Panic Grass
26	<i>Cynodon dactylon</i> (L.) Pers.	Bermuda Grass
28	<i>Aster subulatus</i> Michx.	Aster
29	<i>Aster tenuifolius</i> L.	Aster
30	<i>Solidago sempervirens</i> L.	Seaside Goldenrod
31	<i>Salicornia virginica</i> L.	Perennial Saltwort
32	<i>Fimbristylis castanea</i> (Michx.) Vahl	Salt-Marsh Sedge
33	<i>Tamarix gallica</i> L.	Tamarisk
34	<i>Phytolacca americana</i> L.	Pokeweed
35	<i>Digitaria sanguinalis</i> (L.) Scop.	Crab-Grass
36	<i>Cenchrus pauciflorus</i> Benth.	Field Sand Bur

Code Number: Species number used for two way tables of invading species in Appendix D

Fernald, M. L., Gray's Manual of Botany, 8th ed., Nostrand, New York, 1970

23 cm (6.3%), 30 cm (20.4%), 61 cm (16.6%), and 91 cm (16.5%). Volunteer species in the 8 and 15 cm fills were nearly absent. This, no doubt, was the result of the filled elevation being within the limits of the *Spartina alterniflora* marsh and normal tidal inundation. The few species that appeared (*Baccharis halimifolia*) occurred soon after the filling operation when *Spartina alterniflora* densities were minimal.

102. The 23 cm enclosures were inhabited by *Salicornia virginica*, *Solidago sempervirens*, and *Baccharis halimifolia*, all of which were associated with salt marsh systems of the area. The low species diversity of invading species in these areas was the result of occasional tidal inundation and sufficient *Spartina alterniflora* recovery. The 30 cm enclosures contained the three volunteer species found in the 23 cm areas in addition to *Juncus roemerianus*, *Aster subulatus*, *Aster tenuifolius*, *Tamarix gallica*, and *Phytolacca americana*. The species composition for this height contained both marsh and upland species. Infrequent tidal inundation and depressed *Spartina alterniflora* densities provided more favorable habitat for upland type vegetation.

103. The 61 cm enclosures began to lose the marsh-type species associated with the shallower fill depths. *Juncus roemerianus*, *Aster subulatus*, *Aster tenuifolius*, and *Salicornia virginica* were all absent from the 61-cm enclosures with *Spartina patens*, *Eleusine indica*, *Panicum* sp., *Cynodon dactylon*, *Fimbristylis castanea*, and *Digitaria sanguinalis* all newcomers to the higher elevation. In terms of density, the grass species dominated the vegetation of the 61 cm enclosures. The 61 cm enclosures were rarely inundated by tidal water and were dependent upon rainfall for moisture input. The enclosures isolated and elevated the filled substrate from normal ground water influence, thus, creating a fast draining system leaving the surface much drier than a comparable elevation on the upland. Therefore, vegetation tolerant of poor soils and arid conditions would be expected to survive in these areas. The physical properties



of the substrate were the limiting factors which determined the species composition of the 61 cm enclosures.

104. The 91 cm enclosures had two additional plant species not yet encountered in other enclosures, *Sesbania exaltata* and *Cenchrus pauciflorus*. Those species occupying the 61 enclosures were also found in the 91 cm enclosure with the exception of *Spartina patens*, *Panicum* sp. and *Fimbristylis castanea*, all of which were infrequent species. The arid soil conditions described for the 61 cm enclosures was also prevalent at the 91 cm enclosures. The pokeweed, *Phytolacca americana*, was abundant in a number of the 91 cm enclosures. Several species of birds had many times been observed perched on the 91 cm enclosures, thus, the numerous pokeweed probably were seeded by deposition in the fecal material of the birds.

105. Analysis of the invading species by height classes gave some indication of the elevational regime created by the filling operation. Many of the plant species observed were characteristic of manipulated or otherwise poor soils. The invaders provided some indication of the type of vegetation which could be expected following a similar smothering operation and the number of species as well as the paucity of *Spartina alterniflora* suggested the eventual elimination of *Spartina alterniflora* from several elevational regimes.

#### Invading Plant Species by Dredged Material Type

106. The second set of two-way frequency tables found in Appendix D considered species by dredged material type. Overall plant invasion pressure for each dredged material type was clay (48%), sand (22%), and sand and clay (30%). The higher frequency of invasion for the clay dredged material resulted from its greater water retention and higher nutrient levels. *Baccharis halimifolia* preferred the clay dredged material (80.5%) over the sand dredged material (2.4%) or the sand and clay dredged material (17.1%). *Cynodon dactylon* and *Eleusine*

*indica* were more abundant in the sand dredged material with 66.7% and 50%, respectively, of the invading population occupying these enclosures. *Aster subulatus*, *Aster tenuifolius*, *Solidago semper-virens*, *Salicornia virginica* and *Fimbristylis castanea* all occurred 100% of the time within enclosures containing clay dredged material. The two *Asters* and *Fimbristylis castanea* had low frequencies of occurrence suggesting the trend manifest by these species may just be chance and not a real selection pressure for the clay substrate. *Tamarix gallica* and *Cenchrus pauciflorus* occupied only enclosures containing the sand dredged material. Again, low numbers suggested caution in formulating a concrete association. *Digitaria sanguinalis* preferred the sand dredged material (47%), with the sand and clay (29%), and clay (24%) dredged materials having nearly equal populations of the grass. The only species to be most abundant in the sand and clay dredged material was *Phytolacca americana*. A small portion of the pokeweed population occurred with the clay dredged material (5%) but the majority (95%) of the individuals occurred with the sand and clay dredged material. Species having low frequencies of occurrence were not discussed since the relationships described were more than likely due to chance.

#### Invading Plant Species by Month of Smothering

107. Appendix D. depicts the test for frequency differences between filling months. The February filling enclosures contained the highest frequency of invaders (54%), with the July filling (24%) and the November filling (22%) having about half of the remaining invasion pressure. Species preference by month followed nearly the same pattern set forth by the overall invasion pressure. *Baccharis halimifolia* steadily decreased in invasion pressure from February (59%), to July (27%), to November (15%). *Phytolacca americana* was the only species exhibiting a higher frequency of occurrence in November filled enclosures (85%) than either February (5%) or July (10%). *Spartina*

*patens*, *Baccharis halimifolia*, *Eleusine indica*, *Panicum* sp., *Salicornia virginica* and *Phytolacca americana* were the only species to inhabit the November filled enclosures. The evidence suggested the frequency of invasion and species diversity to be directly related to the length of time available for invasion to take place. Another factor influencing the greater plant invasion with time was the substrate consolidation and in some cases the development of a silt layer and associated microbial activity which would serve as a more favorable medium for attracting and retaining volunteer seeds.

#### Summary

108. The invasion pressure over all was minimal with 88.4% of the experimental enclosures lacking invasion. Several explanations of this lack of invading pressure were: 1) the small size of the enclosures reduced the surface area available to trap seeds; 2) the sandy dredged substrates lacked cohesive and adhesive properties necessary to retain and propagate volunteer seeds; 3) the experimental enclosures were located about 1.5 km from the upland, except for the road bed, and surrounded by salt marshes, therefore, the lack of a sufficient seed source may have been a factor. The necessity of dredged material to accumulate a silt layer, develop better quality soil characteristics (cation exchange capacity) and initiate a microbial community was demonstrated by the Buttermilk Sound Marsh Habitat Development project (Reimold et al. 1978) when significant invasion did not occur until the third growing season after the manipulation of the dredged material. Selection of the elevational regime best suited for survival of each invader was accomplished by segmenting the experimental enclosures by height (elevation above marsh level) and noting the species composition of each level. Marshland versus upland plants were distinguished by enclosure height. The clay dredged material was the most acceptable substrate for invading

species. Although the sandy dredged materials lacked heavy invasion pressure, they were more successful in attracting grasses adapted to arid and poor soil conditions than the clay dredged material. The month of filling illustrated an increase in invasion pressure with time. The time factor was again related to the development of a vegetative cover and to the development of better physical and chemical soil characteristics in the deposited dredged material. Consideration of the quantity and quality of the neighboring seed source was necessary to substantiate the degree of invasion pressure.



## PART VII: COMPREHENSIVE SUMMARY

### Culm Density

109. The effect of the depth of dredged material placed over a marsh was the primary determinator of the degree of marsh recovery as measured by culm density. Each successive increment in depth of dredged material yielded a significantly lower mean culm density. The 61 and 91 cm enclosures yielded essentially no recovery from the smothering operation. Initial recovery was segmented according to depth of dredged material, however, by November 1977 culm densities in the 8, 15 and 23 cm enclosures were similar. The 30 cm enclosures retained somewhat attenuated culm densities in November 1977. The effect of month of deposition produced highest culm densities for the February filling. The month of deposition resulted in different recovery intervals for each filling month and may have been more of a factor in the density differences than the treatment itself. The treatment of dredged material type showed sand and clay dredged material to have the greatest culm density. The smothering operation using the clay dredged material reduced culm densities in each height enclosure more than the sandy dredged materials. The physical nature of the dredged material controlled initial culm densities following smothering. The actual differences between culm density means for each of the dredged material types was small suggesting a longer recovery period may negate any differences.

### Live Crabs and Crab Burrows

110. Crab burrow density and live crab density both documented enclosure height and soil as the significant treatments controlling fiddler and squareback crab populations. Initially, the inability of the crabs to maintain burrows in the sandy dredged materials limited

their distribution. As the surface consistency of these dredged materials was changed by the accumulation of silt and clay particles, the crab populations were able to recolonize the areas. The similarity of the clay dredged material to the underlying marsh resulted in significantly higher crab burrow and live crab densities at all enclosure heights for the clay dredged material. The initial population of *Uca pugnax* crabs was replaced by *Uca pugilator* and *Sesarma reticulatum* in the two sandy dredged materials. Crab burrow density varied inversely to enclosure height, much the same as culm density. Crab burrow densities in 8, 15 and 23 cm enclosures were significantly higher than the taller enclosures and live crab densities were significantly higher in 8 cm enclosures. Live crab and crab burrow densities failed to describe any significant differences to month of smothering.

#### Marsh Snails

111. The two marsh snails exhibited similar significance to the treatment interactions, namely: enclosures height, month, and enclosure height x month. Culm density was significant for the same treatment interactions suggesting the dependence of both species of snails upon the presence of sufficient vegetation to provide habitat for their survival. *Littorina irrorata* and *Melampus bidentatus* densities were significantly greater in 8 and 15 cm enclosures. Dredged material type was a significant factor in determining crab burrow density but failed to produce any significant differences for either snail population. This illustrated different environmental factors to be controlling snail populations than were controlling crab populations. Lower overall mean density for both species of snail in the experimental as well as control areas in 1977 indicated factors other than the experimental treatments to account for the decrease.

### Control Areas

112. A comparison of the three control types revealed both the enclosure controls of 30 cm or less and the 3m x 3m enclosure controls to have slightly higher culm densities than the adjacent marsh controls. This may be an indication of a container effect causing the higher density of *Spartina alterniflora* culms. Enclosure controls of 61 and 91 cm exhibited attenuated culm densities probably due to the restriction of incident sunlight. The adjacent marsh control areas yielded higher densities of live crabs, crab burrows and *Littorina irrorata* than either type of enclosure controls. The 3m x 3m enclosure control had higher densities of *Melampus bidentatus* than either the adjacent marsh or the enclosure controls. The restrictive nature of the enclosure walls was least evident for the *Spartina alterniflora* culm density and most evident in the mobile populations of crabs and snails.

### *Spartina alterniflora* Biomass

113. The estimated biomass measurements for the experimental and control enclosures revealed differences in biomass were related to smothering depth, dredged material type and month of smothering. The largest mean biomass differences resulted from the depth of smothering. Immediately after smothering, the number of culms and rhizomes able to grow through the dredged material was small. The two sandy dredged materials allowed a higher density of culms to emerge than did the clay dredged material. This density trend continued, however, in terms of biomass the clay dredged material produced higher combined live and dead biomass than did either of the sandy dredged materials. The more luxuriant growth of *Spartina alterniflora* in the clay dredged material probably was the result of added nutrients from the dredged material. The gradation of



biomass production versus depth of dredged material showed 8, 15 and 23 cm enclosure heights to have highest biomass production. The overall estimated biomass production for the 8, 15 and 23 cm enclosures in November 1977 was 11% less than the enclosure controls and 46% less than adjacent marsh areas. The similarity of the experimental and control enclosure biomass values indicated the filled enclosures were approaching full recovery within experimental restraints. The 30 cm enclosures produced significantly less biomass than the 8, 15 and 23 cm enclosures and the 61 and 91 cm enclosure biomass values were the result of naturally seeded *Spartina alterniflora* and therefore not a true indicator of recovery from a smothering operation.

114. Biomass differences related to dredged material type described the clay dredged material to have the highest biomass production with the two sandy dredged materials not far behind. The sand dredged material and the clay dredged material yielded similar biomass values for dead material with the sand and clay material producing slightly less dead biomass.

115. The July filling period yielded significantly less combined biomass than either the February or November filling months. Lower dead biomass values for the July filling indicated the lower overall biomass resulted from less growth the previous year since the standing dead would be an indicator of the previous year's growth.

116. Overall biomass increases from April 1977 to November 1977 resulted from substantial increases in the 23 and 30 cm enclosures. The 8 and 15 cm enclosures for all dredged materials maintained lower biomass values than the enclosure controls and adjacent marsh controls. By November 1977, the 8, 15, 23 and 30 enclosures contained similar biomass values; however, levels were still lower than control areas.

117. A comparison of adjacent marsh and enclosure control areas revealed the enclosure controls to have an attenuated mean biomass from that of the adjacent marsh areas. In April 1977 the two control types were similar, but in November 1977 the control



enclosures lacked the recruitment (culm density) and biomass levels of the adjacent *Spartina alterniflora* marsh. The disparity between the two control types indicated a possible container effect was beginning in the enclosures. Restriction of tidal inundation, interstitial water movement or incident sunlight were factors associated with the enclosures which may have attributed to the attenuated culm density and biomass in the enclosure controls. The filled enclosures of 8 and 15 cm approximated the biomass and density values of the enclosure controls suggesting the filled enclosures had attained full recovery within the experimental restraints of the enclosures. Biomass estimates using the regression equations for the adjacent marsh were 33 percent higher than estimates by destructive techniques.

#### Dredged Material Chemistry

118. Initially the clay dredged material was the only dredged material type to possess nutrient levels comparable to adjacent marsh areas. Low available nitrogen and phosphorus levels in the sandy dredged materials increased from 1976 to 1977. Until 1977 the nitrogen concentrations (ammonia and nitrate-nitrite) were lower and phosphorus concentrations (orthophosphate) were higher in the sandy dredged materials than in adjacent marsh controls. The sand dredged material exhibited the least improvement in soil nutrient concentrations of the three dredged materials. Soil salinity was higher in experimental enclosures than in adjacent marsh areas. However, the salinity levels were within the limits determined for a number of adjacent *Spartina alterniflora* marsh types. The low nutrient concentrations and higher salinity levels of the experimental enclosures were not evident when considering culm densities and biomass production from Part IV. A slight production advantage was noted for the clay dredged material which may be related to a more normal soil nutrient environment.

119. Nutrients levels increased for each dredged material faster in the 8 through 23 cm enclosures than for the 30 through 91 cm enclosures. Silt and organic particle accumulation and growth of a microbial community fostered the more rapid increase in nutrient levels within the inundated areas. Although each dredged material made significant increases in nutrient levels, the concentrations remained less than the surrounding *Spartina alterniflora* marsh soil.

#### Invading Plant Species

120. The invasion pressure over all was minimal with 88.4% of the experimental enclosures lacking invasion. Several explanations of this lack of invading pressures were: 1) the small size of the enclosures reduced the surface areas available to trap seeds; 2) the sandy dredged substrates lacked cohesive and adhesive properties necessary to retain and propagate volunteer seeds; 3) the experimental enclosures were located nearly a mile from the upland, except for the road bed, and surrounded by salt marshes, therefore, the lack of a sufficient seed source may have been a factor. The necessity for dredged material to accumulate a silty layer, develop better quality soil characteristics (cation exchange capacity) and initiate a microbial community was demonstrated by the Buttermilk Sound Marsh Habitat Development project (Reimold et al. 1978) when significant invasion did not occur until the third growing season after the manipulation of the dredged material. Selection of the elevational regime best suited for survival of each invader was accomplished by segmenting the experimental enclosures by height (elevation above marsh level) and noting the species composition of each level. Marshland versus upland plants were distinguished by enclosure height. The clay dredged material was the most acceptable substrate for invading species. Although the sandy dredged materials lacked heavy invasion pressure, they were more successful in attracting grasses adapted to arid and poor soil conditions than

the clay dredged material. The month of filling illustrated an increase in invasion pressure with time. The time factor was again related to the development of a vegetative cover and to the development of better physical and chemical soil characteristics in the deposited dredged material. Consideration of the quantity and quality of the neighboring seed source was necessary to substantiate the degree of invasion pressure.

## PART VIII: RECOMMENDATIONS

123. Table 26 provides a summary of the relative success of the plant, crab and snail populations at each of the treatment combinations. The relative scoring system indicates potential detrimental effects to each of the biotic populations imposed by the deposition of dredged material upon the marsh. This table might serve as a tool for management personnel to make objective decisions concerning the most economically feasible and environmentally sound disposal method on *S. alterniflora* marshes.

124. Assessment of the fauna and flora at four week intervals since the establishment of the project revealed that dredged material placed on the surface of the marsh in a layer no thicker than 23 cm (9 inches) does not significantly impede the growth of the marsh plants. *S. alterniflora* was able to penetrate through the 8 cm (3 inches) 15 cm (6 inches), and 23 cm (9 inches) layers of all three types of dredged material. The plants exhibited biological growth and production nearly equal to that of *S. alterniflora* in the control, undisturbed marsh. Fiddler and squareback crab populations were able to survive smothering of 23 cm of dredged material. Crab survival was also a function of dredged material type in terms of burrowing capability and continued burrow integrity. The species of crabs present were dependent upon the texture of the dredged material. Snail populations were destroyed by a smothering operation however recolonization was rapid in 8 and 15 cm depths of dredged material. The return of marsh snails was dependent upon reestablishment of marsh habitat in terms of *S. alterniflora* recovery. Recovery from smothering operations may depend upon the proximity of the disposal area to natural crab and snail populations and the extent of the smothered area may dictate the time necessary for the return of macroinvertebrate populations.

125. The initial effects (through two years of monitoring) of the addition of thin layers of the clay dredged material resulted in an



Table 26 Summary of marsh plant, snail and crab recovery from different depths, times and types of dredged material deposited on a short *Spartina alterniflora* marsh.

unconsolidated depth of material	SAND			SILTY SAND			CLAY		
	Feb fill	July fill	Nov fill	Feb fill	July fill	Nov fill	Feb fill	July fill	Nov fill
8cm	PR= 4 SR= 4 CR= 3	PR= 4 SR= 3 CR= 3	PR= 4 SR= 2 CR= 3	PR= 4 SR= 4 CR= 3	PR= 4 SR= 4 CR= 3	PR= 4 SR= 2 CR= 3	PR= 4 SR= 4 CR= 4	PR= 4 SR= 3 CR= 4	PR= 4 SR= 2 CR= 4
15cm	PR= 4 SR= 4 CR= 2	PR= 4 SR= 3 CR= 2	PR= 4 SR= 1 CR= 2	PR= 4 SR= 4 CR= 2	PR= 4 SR= 2 CR= 2	PR= 4 SR= 2 CR= 2	PR= 4 SR= 4 CR= 4	PR= 4 SR= 2 CR= 4	PR= 4 SR= 1 CR= 3
23cm	PR= 4 SR= 2 CR= 1	PR= 4 SR= 2 CR= 1	PR= 4 SR= 1 CR= 1	PR= 4 SR= 2 CR= 1	PR= 4 SR= 1 CR= 1	PR= 4 SR= 1 CR= 1	PR= 4 SR= 2 CR= 3	PR= 4 SR= 2 CR= 4	PR= 4 SR= 1 CR= 4
30cm	PR= 3 SR= 0 CR= 1	PR= 3 SR= 1 CR= 1	PR= 2 SR= 1 CR= 1	PR= 3 SR= 2 CR= 1	PR= 2 SR= 1 CR= 1	PR= 3 SR= 1 CR= 1	PR= 3 SR= 2 CR= 2	PR= 2 SR= 1 CR= 2	PR= 2 SR= 1 CR= 2
61cm	PR= 0 SR= 0 CR= 0	PR= 0 SR= 0 CR= 0	PR= 1 SR= 0 CR= 0	PR= 0 SR= 0 CR= 1	PR= 0 SR= 0 CR= 0	PR= 1 SR= 0 CR= 1	PR= 1 SR= 0 CR= 0	PR= 0 SR= 0 CR= 0	PR= 1 SR= 0 CR= 0
91 cm	PR= 0 SR= 0 CR= 0	PR= 0 SR= 0 CR= 0	PR= 1 SR= 0 CR= 0	PR= 0 SR= 0 CR= 0	PR= 0 SR= 0 CR= 1	PR= 1 SR= 0 CR= 0	PR= 0 SR= 0 CR= 0	PR= 0 SR= 0 CR= 0	PR= 1 SR= 0 CR= 0
PR= plant recovery SR= snail recovery CR= crab recovery									
4 = EXCELLENT 3 = GOOD 2 = AVERAGE 1 = POOR 0 = NO RECOVERY									

increased growth in the plant population. It appears that the thin layer of dredged material containing additional nutrients was adequate to supply the small additional amount of nitrogen needed by many coastal wetland plants to show a response in the form of increased growth. By the termination of the two year monitoring period the plant growth was analogous to that of the sandy dredged materials indicating the eventual equality of all three dredged materials. One of the limiting factors in conducting such a disposal methodology as this would be to assure that the dredged materials were deposited in a uniform thickness layer on the surface of the marsh. The effect of season did not appear to have relevance to the outcome of the success of this means of disposal.

124. As indicated by the experimental plant response and the invading species occurrence, the 8 through 23 cm filling depths were within the elevational range of the *S. alterniflora* marsh. Filling to a depth outside the normal marsh elevation would reduce or eliminate the ability of the underlying marsh to recover as seen by the 30 through 91 cm filling depths. Therefore, it is necessary to collect accurate tidal and elevational data for the marsh being smothered to assure the resultant elevation after the deposition of the dredged material is within the elevational limits of similar contiguous marshes.

125. The smothering of existant *S. alterniflora* high marsh with dredged material is a feasible disposal alternative but should only be employed when the feasibility of other disposal alternatives are economically or physically impossible. The assurance of a uniform layer of unconsolidated dredged material not to exceed the elevational regime of existing *S. alterniflora* marshes is essential to the continued survival of the salt marsh. The effects of the smothering operation have been documented for *S. alterniflora*, fiddler crabs and marsh snail populations; however, effects upon microbial, other invertebrate and vertebrate populations have not been addressed. Until the effects upon all the biotic communities and the abiotic environment resulting from a smothering operation

have been determined, this dredged material disposal alternative should be used with caution. More research, including the actual smothering of a small marsh area is essential before this alternative can be declared ecologically sound.

## REFERENCES

- Armstrong, F. A., C. R. Sterns, and J. D. H. Strickland. 1967.  
The measurement of upwelling and subsequent biological processes by means of the techicon autoanalyzer and associated equipment. *Deep-Sea Research* 14: 381-389.
- Barr, A. J., J. H. Goodnight, J. P. Sall, and J. T. Helwig. 1976.  
A user's guide to SAS 76, 5th Printing. Sparks Press. Raleigh, N. C. 329 pp.
- Chapman, H. D. 1965. Cation-exchange capacity. In: C. A. Black (Ed.). *Methods of Soils Analysis Part 2*. Agronomy 9: 891-901.
- Federal Water Pollution Control Administration. 1969. *Methods for Chemical Analysis of Water and Wastes*. 137 pp.
- Gallagher, J. L., R. J. Reimold, R. A. Linthurst, and W. J. Pfeiffer. (In press). Aerial production, mortality, and mineral accumulation dynamics in *Spartina alterniflora* and *Juncus roemerianus* in a Georgia salt marsh. (Ecology).
- Reimold, R. J., M. A. Hardisky, and P. C. Adams. 1978. Habitat development field investigations, Buttermilk Sound marsh development site, Atlantic Intracoastal Waterway, Georgia. Appendix A: Propagation of marsh plants and postpropagation monitoring. TR D-78-26. U. S. Army Engineer Waterways Experiment Station, Vicksburg, Miss.
- Issac, R. A. and J. B. Jones. 1971. AutoAnalyzer system for the analysis of soil and plant tissue extracts. In: Technicon International Congress 1970, Tarrytown, N. Y. pp. 57-64.
- Issac, R. A. and J. D. Kerber. 1971. Atomic absorption and flame photometry: technique and uses in soil, plant, and water analysis. In: L. M. Walsh (Ed.) *Instrumental Methods of Analysis of Soils and Plant Tissue*. Soil Sci. Soc. Amer., Madison, Wis., pp. 17-37.
- Jackson, M. L. 1958. *Soil Chemical Analysis*, Prentice-Hall, Inc., Englewood Cliffs, N. J. pp. 219-220
- Jones, J. B. and R. A. Issac. 1972. Determination of sulfur in plant material using a leco sulfur analyzer. *J. Agr. and Food Chem.* 20 (6): 1292-1294.



- Nelson, W. L., A. Mehlich, and E. Winters. 1953. The development, evaluation, and use of soil tests for phosphorus availability. In: W. H. Pierre and A. G. Norman (Eds.). Soil and Fertilizer Phosphorus. Agronomy, A Series of Monographs, Academic Press, Inc. N. Y. 2: 153-188.
- Nixon, S. W. and C. A. Oviatt. 1973. Ecology of a New England salt marsh. *Ecol. Monogr.* 43(4): 463-498.
- Pearsall, W. H. and C. H. Mortimer. 1939. Oxidation-reduction potentials in waterlogged soils, natural waters, and muds. *J. Ecol.* 27: 483-501.
- Peech, M. 1965. Hydrogen-ion activity. In: C. A. Black (Ed.). Methods of Soil Analysis, Part 2. Chemical and Microbiological Properties #9, Amer. Soc. Agron, Madison, Wis. pp.914-925.
- Perkins, H. F. 1970. A rapid method of evaluating the zinc status of coastal plain soils, Comm. in Soil Sci. and Plant Anal. 1: 35-46.
- Reimold, R. J. and M. A. Hardisky. Non-Destructive Estimation of Salt Marsh Plant Biomass. In Preparation.
- Reimold, R. J. and R. A. Linthurst. 1977. Primary Productivity of Minor Marsh Plants in Delaware, Georgia, and Maine. Technical Report D-77-36. U. S. Army Engineer Waterways Experiment Station, Vicksburg, Miss. pp. 104.
- Saunders, W. M. H. 1965. Phosphate retention by New Zealand soils and its relationship to free sesquioxides, organic matter, and other soil properties. *New Zealand J. Agric. Res.* 8: 30-57.
- Technicon. 1973. Total inorganic phosphate in water and wastewater. Method #93-70W Technicon Industrial Systems, Tarrytown, New York.
- Technicon. 1975. Digestion and sample preparation for the analysis of total Kjeldahl nitrogen. Method #376-75W. Technicon Industrial Systems, Tarrytown, New York.
- Toth, S. J. and A. N. Ott. 1970. Characterization of bottom sediments: cation exchange capacity and exchangeable cation status. *Environmental Science and Technology* 4(11): 935-939.

- Turner, R. E. and J. G. Gosselink. 1975. A note on standing crop of *Spartina alterniflora* in Texas and Florida. Contributions in Marine Science. 19: 113-118.
- Williams, R. B., and M. B. Murdock. 1969. The potential importance of *Spartina alterniflora* in conveying zinc, manganese, and iron into estuarine food chains. Proceedings of the Second National Symposium on Radioecology. USAEC. CONF-670503. Ann Arbor Mich.
- Van Slyke, D. D. and A. J. Hiller. 1933. The determination of ammonia in blood. Journal of Biological Chemistry. 102: 499-504.
- Wolf, B. 1971. The determination of boron in soil extracts, plant materials, composts, manures, water, and nutrient solutions. Comm. Soil Sci. Plant Anal. 2 (5): 363-374.
- Wolf, P. L., S. Shanholtzer, and R. J. Reimold. 1975. Population estimates of *Uca pugnax* (Smith, 1970) on the Duplin Estuary Marsh, Georgia. U.S.A. Crustaceana, 29 (1): 79-91.

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ix, 114 p. : ill. ; 27 cm. (Technical report - U. S. Army Engineer Waterways Experiment Station ; D-78-38)

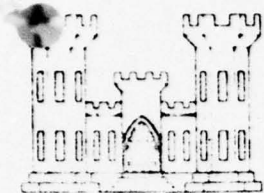
Prepared for Office, Chief of Engineers, U. S. Army, Washington, D. C., under Contract No. DACW21-75-C-0074 (DMRP Work Unit No. 2A07)

Appendices A-D on microfiche in pocket.

References: p. 112-114.

1. Dredged material. 2. Dredged material disposal. 3. Marsh development. 4. Salt marshes. 5. Vegetation establishment. I. Adams, Patrick C., joint author. II. Hardisky, Michael A., joint author. III. Georgia. University. Marine Extension Service. IV. United States. Army. Corps of Engineers. V. Series: United States. Waterways Experiment Station, Vicksburg, Miss. Technical report ; D-78-38.

TA7.W34 no.D-78-38



# DREDGED MATERIAL RESEARCH PROGRAM



TECHNICAL REPORT D-78-38

THE EFFECTS OF SMOTHERING A SPARTINA ALTERNIFLORA

SALT MARSH WITH DREDGED MATERIAL

by

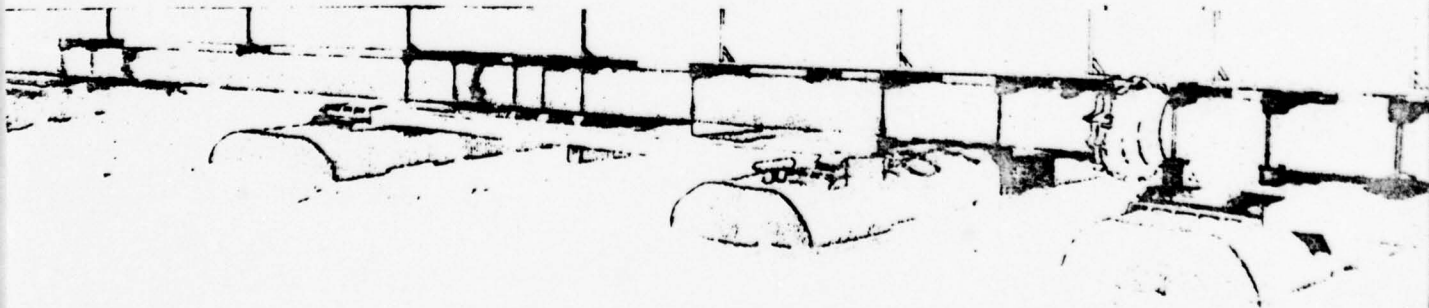
Robert J. Reimold, Michael A. Hardisky, Patrick C. Adams

Marine Extension Service  
University of Georgia  
Brunswick, Ga. 31520

July 1978

Final Report

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED



Prepared for Office, Chief of Engineers, U. S. Army  
Washington, D. C. 20314

Under Contract No. DACW21-75-C-0074  
(DMRP Work Unit No. 2A07)

Monitored by Environmental Laboratory  
U. S. Army Engineer Waterways Experiment Station  
P. O. Box 631, Vicksburg, Miss. 39180

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## APPENDIX A

### ANALYSIS OF VARIANCE FOR MARSH SMOTHERING ENCLOSURE AND CONTROL AREAS

Parts 1-3

#### Legend for Dependent Variable Codes

cul	=	Live culms /m <sup>2</sup>
crab	=	Live crabs /m <sup>2</sup>
bur	=	Crab burrows /m <sup>2</sup>
lit	=	<i>Littorina irrorata</i> /m <sup>2</sup>
mel	=	<i>Melampus bidentatus</i> /m <sup>2</sup>
lit_log	=	Natural log of <i>L. irrorata</i> /m <sup>2</sup>
mel_log	=	Natural log of <i>M. bidentatus</i> /m <sup>2</sup>

#### Legend of Class Variable Codes

<u>Height</u>	=	Enclosure height
3	=	8 cm
6	=	15 cm
9	=	23 cm
12	=	30 cm
24	=	61 cm
36	=	91 cm
<u>Soil</u>	=	Dredged Material type
SA	=	Sand
SI	=	Sand and Clay
CL	=	Clay

Mon        = Month of Deposition  
F            = February 1975  
J            = July 1976  
O            = November 1976

## Part 2

### Legend for Class Variable

#### Control

1            = Control enclosures ( $0.656 \text{ m}^2$ )  
0            = Experimental enclosures ( $0.656 \text{ m}^2$ )

## Part 3

### Legend for Class Variable

#### Control 2

0            = Experimental enclosures  
1            = Adjacent Marsh Control areas

#### Control 3

0            = Experimental enclosures  
1            = 3m x 3m Enclosure Control areas

#### Control

0            = Experimental enclosures  
1            =  $0.656 \text{ m}^2$  enclosure controls

## PART 1

Analysis of Variance

General Linear Model

Dependent variables by height, soil and month for experimental enclosures

PART 2

Analysis of Variance

General Linear Model

Dependent variabler by height for experimental and control  
0.656 m<sup>2</sup> enclosures

PART 3

Analysis of Variance

General Linear Model

Dependent variables of Experimental enclosures by control type.

PART 1



STATISTICAL ANALYSIS SYSTEM 13:02 THURSDAY, APRIL 24, 1970 1

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
HEIGHT	0	3 6 9 12 24 30
SOIL	3	CL SA SI
NOI	3	F J O

NUMBER OF OBSERVATIONS IN DATA SET = 1728

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: CUL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	53	12829244.2771907	242061.2127734	107.22	0.0001	0.772453	43.6997
ERROR	1674	5779197.4305556	2257.58501596		STD DEV		CUL MEAN
CORRECTED TOTAL	1727	18608441.7077463			47.51605164		108.72258796

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
HEIGHT	5	11958581.89178265	1059.41	0.0001	5	11189007.99922841	991.24	0.0001
SOIL	2	60332.67080195	15.36	0.0001	2	59541.66159612	15.10	0.0001
HEIGHT*SOIL	10	116362.88912037	5.15	0.0001	10	107692.97729777	4.50	0.0001
MON	2	233229.14834105	51.65	0.0001	2	233229.14834105	51.65	0.0001
HEIGHT*MON	10	292012.63152006	12.93	0.0001	10	292012.63152006	12.93	0.0001
SOIL*MON	4	32779.97223765	3.63	0.0059	4	32779.97223765	3.63	0.0059
HEIGHT*SOIL*MON	20	135945.66859568	7.01	0.0001	20	135945.66859568	7.01	0.0001

STATISTICAL ANALYSIS SYSTEM 1306 THURSDAY, APRIL 20, 1978 3  
GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: CHAB							
SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	55	3981.63240741	75.11281901	4.31	0.0001	0.120122	545.7910
ERROR	1674	25160.5135069	17.61946182		STD DEV		CHAB MEAN
CORRECTED TOTAL	1727	31141.54629631			4.17367694		0.72275630

SOURCE	DF	TYPE I SS	F VALUE	PR > F	TYPE III SS	F VALUE	PR > F
HEIGHT	5	2015.51157407	23.14	0.0001	2053.40002265	23.58	0.0001
SOIL	2	576.02395512	16.42	0.0001	580.61529412	16.57	0.0001
HEIGHT*SOIL	10	1126.15162317	6.46	0.0001	1152.75507155	6.42	0.0001
NO3	2	12.74151235	0.37	0.6938	12.74151235	0.37	0.6938
HEIGHT*NO3	10	58.40324691	0.24	0.9721	58.40324691	0.23	0.9721
SOIL*NO3	4	32.50035553	0.47	0.7694	32.50035553	0.47	0.7694
HEIGHT*SOIL*NO3	20	156.19311277	0.45	0.9925	156.19311277	0.45	0.9925

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: SUM

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	L.V.
MODEL	53	52279.86574076	608.86530133	24.42	0.0001	0.436041	223.2127
ERROR	1674	417180.65277772	249.35133380		STD DEV		RUR MEAN
CORRECTED TOTAL	1727	740090.51851852			15.79022906		7.07417617

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
HEIGHT	5	121341.42129630	97.33	0.0001	5	110972.97806437	96.24	0.0001
SOIL	2	26409.65185185	174.00	0.0001	2	83179.89043210	166.23	0.0001
HEIGHT*SOIL	10	98175.82870370	59.28	0.0001	10	97261.76300705	39.01	0.0001
MOON	2	339.89040123	0.68	0.5060	2	339.89040123	0.68	0.5060
HEIGHT*MOON	10	4180.95293210	1.68	0.0807	10	4180.95293210	1.68	0.0807
SOIL*MOON	4	439.29781951	0.67	0.7926	4	439.29781951	0.67	0.7926
HEIGHT*SOIL*MOON	20	11442.63271605	2.79	0.0009	20	11442.63271605	2.79	0.0009



GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: LIT

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	53	20.4166667	0.38522013	2.36	0.0001	0.069622	645.5322
ERROR	1674	272.8333333	0.16292296		STR DEV		LIT MEAN
CORRECTED TOTAL	1727	293.2500000		0.4037115			0.0625000

SOURCE	DF	TYPE I SS	F VALUE	PR > F	TYPE IV SS	F VALUE	PR > F
HEIGHT	5	5.9236111	7.27	0.0001	5.54497354	6.80	0.0001
SOIL	2	0.2634532	0.31	0.4452	0.36705524	1.11	0.3285
HEIGHT*SOIL	10	1.0833333	0.66	0.7581	0.71496709	0.44	0.8280
WON	2	2.11419755	6.49	0.0016	2.11419755	6.49	0.0016
HEIGHT*WON	10	6.1268802	3.76	0.0001	6.1268802	3.76	0.0001
SOIL*WON	4	0.60707407	0.91	0.4469	0.60707407	0.91	0.4469
HEIGHT*SOIL*WON	20	4.29475509	1.52	0.1566	4.29475509	1.52	0.1566

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: MEL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	TYPE III SS	F VALUE	PR > F	C.V.
MODEL	53	4337.17972695	157.20528258	5.09	0.0001	4140.58564715	26.42	0.0001	592.6066
ERROR	1674	51692.58611111	30.87520002			9.66071429	0.16	0.8552	
CORRECTED TOTAL	1727	60030.16683806				25.00462963	0.07	1.0000	
						1033.86593364	16.42	0.0001	
SOURCE	DF	TYPE I SS	F VALUE	PR > F		1707.66066673	5.53	0.0001	
MEANF	5	5172.10706019	12.53	0.0001		78.51427649	0.64	0.4371	
SOIL	2	16.93171295	0.24	0.7853		307.02507716	0.50	0.5068	
MEANF*SOIL	10	38.0723314	0.12	0.9056					
ERROR	2	1033.86593364	16.42	0.0001					
MEAN*SOIL	10	1707.66066673	5.53	0.0001					
SOIL*SOIL	4	78.51427649	0.64	0.6371					
MEAN*SOIL*SOIL	20	307.02507716	0.50	0.9882					

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: LIT\_LOG

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	53	5.64529731	0.10659435	2.65	0.0001	0.077597	612.2792
ERROR	1474	60.14216582	0.04082222		STD DEV		LIT_LOG MEAN
CORRECTED TOTAL	1527	65.78746014			0.18554476		0.0205129

SOURCE	DF	TYPE I SS	F VALUE	PR > F	TYPE III SS	F VALUE	PR > F
HEIGHT	5	1.52427773	8.76	0.0001	1.40444106	7.82	0.0001
SOIL	2	0.03099719	0.43	0.6457	0.04452251	0.42	0.5187
HEIGHT*SOIL	10	0.29246485	0.81	0.6155	0.19136105	0.53	0.4680
SOIL	2	0.61471623	2.56	0.0002	0.48491223	2.56	0.0002
HEIGHT*SOIL	10	1.46611987	4.78	0.0001	1.46611987	4.78	0.0001
SOIL*SOIL	4	0.13554345	0.94	0.4458	0.13554345	0.94	0.4458
HEIGHT*SOIL*SOIL	20	0.93256792	1.30	0.1653	0.93256792	1.30	0.1653

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: MEL_LOG	
SOURCE	DF
MODEL	53
ERROR	1674
CORRECTED TOTAL	1727

SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
250.5794194	4.72791475	10.64	0.0001	0.25197	235.1780
745.8511447	0.44436471		STD DEV		MEL_LOG MEAN
994.4125641			0.66659192		0.2770119

SOURCE	DF	TYPE I SS	F VALUE	PR > F	TYPE IV SS	F VALUE	PR > F
HEIGHT	5	153.8305982	69.24	0.0001	126.5873611	56.95	0.0001
SOIL	2	0.3531037	0.40	0.6720	0.30187546	0.24	0.7120
HEIGHT*SOIL	10	2.4033129	0.55	0.8426	2.17568071	0.49	0.9477
SOIL	2	34.30382415	38.60	0.0001	34.30382415	38.60	0.0001
HEIGHT*SOIL	10	53.10040537	11.95	0.0001	53.10040537	11.95	0.0001
HEIGHT*SOIL	4	1.17223395	0.66	0.6272	1.17223395	0.66	0.6272
HEIGHT*SOIL*SOIL	20	5.33775765	0.60	0.9149	5.33775765	0.60	0.9149



S T A Y J S Y I C A L A M A L Y S I S S Y S T E M 12:02 THURSDAY, APRIL 27, 1978 9

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE COL

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=1676 RSQ=7257.59

GROUPING	MEAN	N	HEIGHT
A	217.847222	248	5
B	186.777778	248	6
C	166.595694	248	9
D	92.777778	248	12
E	1.278157	248	14
F	0.794722	248	56

13:00 THURSDAY, APRIL 21, 1976 10

STATISTICAL ANALYSIS SYSTEM  
GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE C=46

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=1674 PS=17.4307

GROUPING	MEAN	N	HEIGHT
A	5.072917	248	3
B	0.710583	248	6
C	6.479167	248	9
D	0.097222	248	12
E	0.013929	248	24
F	0.000000	248	56

STATISTICAL ANALYSIS SYSTEM 1502 THURSDAY, APRIL 20, 1978 11

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE RUM

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 SS=1676 MS=249.333

GROUPING	MEAN	N	WEIGHT
A	24.12128	288	3
B	8.975694	288	6
B	7.461866	288	6
C	1.868056	288	12
C	0.015417	288	24
C	0.006944	288	36

STATISTICAL ANALYSIS SYSTEM 13:02 THURSDAY, APRIL 20, 1978 1c

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE LIT

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=1674 F=0.147983

GROUPING	MEAN	N	HEIGHT
A	0.142361	288	3
A	0.138899	288	6
B	0.052283	288	12
B	0.041667	288	9
C	0.000000	288	24
C	0.000000	288	36



STATISTICAL ANALYSIS SYSTEM 13:17 THURSDAY, APRIL 20, 1978 13

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE WEE

VALUES WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=1674 P<=0.0001

GROUPING	MEAN	N	HEIGHT
A	4.57963	256	5
B	2.871528	256	6
C	0.001644	256	9
C	0.170130	256	12
C	0.000000	256	24
C	0.000000	256	36

STATISTICAL ANALYSIS SYSTEM 13:12 THURSDAY, APRIL 26, 1972 14

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE LIT\_LUG

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DE=1674 PS=.0359272

GROUPING	MEAN	N	WEIGHT
A	0.075475	288	3
A	0.067945	288	6
A	0.023478	288	12
B	0.018664	288	9
B	0.000000	288	24
B	0.010000	288	36

STATISTICAL ANALYSIS SYSTEM 13500 THURSDAY, APRIL 20, 1972 15

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VAR1#01 WEL\_06

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=1674 MS=0.444445

GROUPING	MEAN	N	HEIGHT
A	0.773532	268	3
B	0.578720	268	6
C	0.248626	268	9
D	0.071323	268	12
D	0.000000	268	24
D	0.000000	268	36

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE CUL

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=1674 MS=2257.59

GROUPING	MEAN	N	SOIL
A	116.098562	576	S1
B	108.475694	576	SA
C	101.621528	576	CL



STATISTICS IN A P S S S Y S T E M 11:02 THURSDAY, APRIL 26, 1972 17

GENERAL LINEAR MODEL PROCEDURE

SUNGEN'S MULTIPLE RANGE TEST FOR VARIABLE CHAB

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DEFA/4 MS17.6577

GROUPING	MEAN	N	SOIL
A	1.552083	576	CL
B	0.745446	576	SI
C	0.403359	576	SA

STATISTICAL ANALYSIS SYSTEM 13:02 THURSDAY, APRIL 20, 1978 15

GENERAL LINEAR MODEL PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE EUP

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=1674 MS=240.331

GROUPING	MEAN	N	SOIL
A	17.09722	576	CL
B	2.152778	576	SI
B	1.97222	576	SA

STATISTICS FOR JULY 15 SYSTIM 13:00 THURSDAY, APRIL 27, 1978 15

GENERAL LINEAR MODEL PROCEDURE

DUJENTS MULTIPLE RANGE TEST FOR VARIABLE LIT

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=1676 RSQ=.142843

GROUPING	MEAN	N	SOIL
A	0.079841	576	CL
A	0.055556	576	SA
A	0.052083	576	SI

STATISTICAL ANALYSIS SYSTEM 13:02 THURSDAY, APRIL 20, 1978 20

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE WEL

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=1674 PS=30.2709

GROUPING	MEAN	N	SOIL
A	1.503472	576	CL
A	1.460069	576	SA
A	1.228194	576	SI



STATISTICAL ANALYSIS SYSTEM 1970 THURSDAY, APRIL 20, 1976 43

CENTRAL LITHIUM MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE LIT\_100

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=1676 P=0.0550277

GROUPING	MEAN	N	SOIL
A	0.036624	576	CL
A	0.029609	516	SA
A	0.026496	576	SI

GENERAL LINEAR MODELS PROCEDURE

LUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE MEL\_LOG

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=1674 PS=0.444345

GROUPING	MEAN	N	SOIL
A	0.297514	576	SA
A	0.275525	576	SI
A	0.262994	576	CL

STATISTICAL ANALYSIS SYSTEM 1970 03

GENERAL LINEAR MODEL PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE CUL

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

SOURCE OF VARIATION SS DF MS F

GROUPING	MEAN	N	MS
A	125.549504	648	F
B	102.243056	652	D
B	98.191358	648	J

STATISTICAL ANALYSIS SYSTEM 13:02 THURSDAY, APRIL 20, 1978 24

GENERAL LINEAR MODELS PROCEDURE

DUICAN'S MULTIPLE RANGE TEST FOR VARIABLE CHAD

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=1674 MS=17.4147

GROUPING	MEAN	N	PON
A	0.265626	452	0
A	0.759198	648	J
A	0.641975	648	F



STATISTICAL ANALYSIS SYSTEM 11:12 THURSDAY, APRIL 20, 1978 25

GENERAL LINEAR MODEL PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE BUR

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL = .05 DF=1674 F5=249.753

GROUPING	MEAN	N	WON
A	7.544753	648	J
A	7.182870	432	C
A	6.530664	648	F

STATISTICAL ANALYSIS SYSTEM 15:02 THURSDAY, APRIL 20, 1978 26

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE LIT

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=1674 PS=0.152993

GROUPING	MEAN	N	PON
A	0.100305	648	F
A			
A	0.069444	432	O
B			
3	0.020062	648	J
3			

STATISTICAL ANALYSIS SYSTEM 1300 THURSDAY, APRIL 26, 1976 07

GENERAL LINEAR MODELS PROCEDURE

DISCAN'S MULTIPLE RANGE TEST FOR VARIABLE WIL

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 05=1076 PS=90.5799

GROUPING	MEAN	N	MON
A	2.262766	665	F
B	1.320988	665	J
C	0.293951	432	U

STATISTICAL ANALYSIS SYSTEM 13:02 THURSDAY, APRIL 20, 1976 26

GENERAL LINEAR MODELS PROCEDURE

LUNCAU'S MULTIPLE RANGE TEST FOR VARIABLE LIT\_LOG

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=1674 F=0.050222

GROUPING	MEAN	N	MON
A	0.053081	648	F
A	0.029695	432	O
B	0.009547	648	J



STATISTICAL ANALYSIS SYSTEM 13:12 THURSDAY, APRIL 20, 1978 24

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE MIL\_LUG

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=1674 MS=1.442365

GROUPING	MEAN	N	MON
A	0.447647	648	F
B	0.231727	648	J
C	0.096014	432	O

GENERAL LINEAR MODELS PROCEDURE

MEANS

WEIGHT	SOIL	N	CUL	CRAB	BUR	LIT	MEL	LIT_LOG	MEL_LOG
3	CL	96	196.552083	0.42291667	54.458333	0.17704533	4.74375000	0.18999721	0.76432010
3	SA	96	226.302083	1.42703333	9.21975000	0.17616667	4.49750000	0.19521939	0.76662774
3	SI	96	230.147500	1.49675000	8.62750000	0.16583333	4.20833333	0.18010715	0.75966666
6	CL	96	166.343750	1.77844444	27.522500	0.13616667	3.11645333	0.17445661	0.45122922
6	SA	96	191.273750	0.40833333	1.8594167	0.17208333	2.71925000	0.17453771	0.61651965
6	SI	96	192.250000	0.36203333	2.4827500	0.13541667	2.76135000	0.16443967	0.29991123
9	CL	96	159.375000	1.33125000	0.13475000	0.17183333	1.54416667	0.16454861	0.24442466
9	SA	96	142.229167	0.12500000	0.50000000	0.17183333	1.29526333	0.17144328	0.34441529
9	SI	96	165.322917	0.28125000	1.447167	0.06000000	0.55203333	0.17620000	0.13731156
12	CL	96	90.725167	0.24166667	0.229167	0.03725000	0.11453333	0.17453192	0.17745929
12	SA	96	95.531250	0.36000000	0.260167	0.03725000	0.17500000	0.17444057	0.16621509
12	SI	96	102.072917	0.36000000	0.09000000	0.03725000	0.00000000	0.17444057	0.16621509
24	CL	96	14.625000	0.70000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
24	SA	96	4.585417	0.02083333	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
24	SI	96	2.614583	0.22633333	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
36	CL	96	2.316167	0.20000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
36	SA	96	0.166667	0.36000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
36	SI	96	0.083333	0.20000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000

HEIGHT	MUR	N	CUL	CRAB	BUR	LIT	MEL	LIT_LOG	MEL_LOG
3	F	108	259.490761	2.67962961	22.0925926	0.30555556	7.18518519	0.16057621	1.29220675
3	J	108	196.861111	3.30925926	24.0925926	0.03703704	0.40760741	0.102034467	0.59659094
3	O	72	166.203111	3.53555556	27.2105555	0.03555556	0.90555556	0.03555556	1.01956012
6	F	108	212.046796	0.79629630	11.0048162	0.21790296	5.10195154	0.11655642	1.99644787
6	J	108	167.279631	0.75000000	9.0761631	0.03703704	2.1592593	0.06038460	0.46625662
6	O	72	169.222222	0.53888889	5.6764666	0.14555556	1.69444444	0.06902519	0.14563462
9	F	108	151.261162	0.5745064	6.0767631	0.16681641	1.1015175	0.05518073	0.14563462
9	J	108	162.293515	0.53555556	1.2797593	0.06296531	1.17666667	0.10598587	0.23309900
9	O	72	166.694444	0.61111111	4.4272222	0.03703704	0.15300000	0.00000000	0.20541226
12	F	108	113.175926	0.12030303	1.5757037	0.03751932	0.15315819	0.11172534	0.17115277
12	J	108	74.092593	0.39259259	1.2647741	0.00000000	0.17525553	0.17275723	0.06821610
12	O	72	92.201233	0.38944444	3.8055556	0.13555556	0.13848889	0.00000000	0.19762952
24	F	108	5.620370	0.3185152	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
24	J	108	2.740761	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
24	O	72	16.291667	0.37777778	0.0416667	0.00000000	0.00000000	0.00000000	0.00000000
36	F	108	0.000000	0.50000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
36	J	108	0.658889	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
36	O	72	2.180556	0.36000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000

SOIL	MON	N	CUL	CRAB	BUR	LIT	MEL	LIT_LOG	MEL_LOG
CL	F	216	119.157407	1.58195469	16.4351852	0.11111111	4.57970370	0.05618913	0.43907846
CL	J	216	87.457333	1.53703704	17.8762996	0.07344111	1.27346667	0.10029518	0.23153780
CL	O	144	96.100000	1.81964444	16.9146667	0.11555556	0.20823833	0.04977110	0.20127233
SA	F	216	168.104027	0.45981667	2.0005555	0.09742222	2.00000000	0.05219354	0.24347857
SA	J	216	95.310667	0.25611111	1.955152	0.05715004	1.27991483	0.01544607	0.04303067
SA	O	144	99.166667	1.20156889	1.6736111	0.06083333	1.50555556	0.01962704	0.10016450

STATISTICAL ANALYSIS SYSTEM THURSDAY, APRIL 20, 1972 31

GENERAL LINEAR MODEL PROCEDURE

WEIGHTS

CELL	ROW	N	CUL	CRAB	WUR	LIT	REL	LIT_LUG	REL_LUG
51	F	215	123.445074	0.0772222	0.0400241	0.00255259	2.20531325	0.05046768	0.47284576
51	F	214	111.554259	0.44444444	0.0400241	0.00255259	0.05046768	0.05046768	0.16281766
51	F	214	111.77167	0.55555556	0.0400241	0.00255259	0.05046768	0.05046768	0.16281766

PART 2

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STATISTICAL ANALYSIS SYSTEM 15:00 THURSDAY, APRIL 20, 1968 32

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
HEIGHT	4	3 6 9 12 24 36
CONTROL	2	0 1

NUMBER OF OBSERVATIONS IN DATA SET = 1944

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: CUL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	11	13773965.12332319	1252178.64757529	402.67	0.0001	0.696290	47.4017
ERROR	1912	6007961.12152775	3109.7172542		STD DEV		CUL MEAN
CORRECTED TOTAL	1943	19781926.24485597			55.76676033		117.64300412

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
HEIGHT	5	11905136.24485597	765.67	0.0001	5	3054751.13303757	196.47	0.0001
CONTROL	1	1235587.91211134	397.42	0.0001	1	1235587.91211134	397.42	0.0001
HEIGHT*CONTROL	5	632960.96637098	40.71	0.0001	5	632960.96637098	40.71	0.0001

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: CRAB

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	11	5609.1777634	291.746667	16.72	0.0001	0.077547	482.9063
ERROR	1932	30281.2391667	19.8143001		STD DEV		CRAB MEAN
CORRECTED TOTAL	1943	41490.4069302			4.45132574		0.96347737

SOURCE	DF	TYPE 1 SS	F VALUE	PR > F	TYPE III SS	F VALUE	PR > F
HEIGHT	5	2001.9902264	29.21	0.0001	724.67206790	7.31	0.0001
CONTROL	1	620.4207177	41.41	0.0001	870.4728189	41.61	0.0001
HEIGHT*CONTROL	5	386.76071611	3.90	0.0017	386.76071611	3.90	0.0017

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: GUN

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	11	127119.73611111	11556.35964646	33.67	0.0001	0.160860	251.6819
ERROR	1952	663126.7638889	342.27436974		STD DEV		18.7554
CORRECTED TOTAL	1963	790246.5000000			18.52058495		7.36111111

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DI	TYPE IV SS	F VALUE	PR > F
HEIGHT	5	117276.68518519	68.34	0.0001	5	26397.67646053	15.58	0.0001
CONTROL	1	1281.33333333	3.73	0.0555	1	1281.33333333	3.73	0.0555
HEIGHT*CONTROL	5	8561.71759259	4.99	0.0002	5	8561.71759259	4.99	0.0002



STATISTICAL ANALYSIS SYSTEM

13:12 THURSDAY, APRIL 20, 1978

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GENERAL LINEAR MODEL PROCEDURE

DEPENDENT VARIABLE: LIT

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	P-SQUARE	C.V.
MODEL	11	36.4663069	3.31511878	5.14	0.0001	0.02430	934.9159
ERROR	1032	1246.1875000	0.64202459		STD DEV		LIT MEAN
CORRECTED TOTAL	1043	1282.6538069			F=80313623		0.0055555

SOURCE	DF	TYPE I SS	F VALUE	PR > F	TYPE IV SS	F VALUE	PR > F
HEIGHT	5	7.25565944	2.25	0.0666	19.77752058	6.13	0.0001
CONTROL	1	8.51954733	13.21	0.0003	8.51954733	13.21	0.0003
HEIGHT*CONTROL	5	20.69110082	6.42	0.0001	20.69110082	6.42	0.0001

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: HEL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	11	4825.54745370	202.32249579	19.37	0.0001	0.1094351	365.4646
ERROR	1952	40006.22509444	41.41108990		STD DEV		HEL MEAN
CORRECTED TOTAL	1963	48831.77314815			6.43514480		1.76022247

SOURCE	DF	TYPE I SS	F VALUE	PR > F	TYPE III SS	F VALUE	PR > F
HEIGHT	5	6159.26117294	29.25	0.0001	3543.27942644	17.11	0.0001
CONTROL	1	1835.62557870	44.33	0.0001	1835.62557870	44.33	0.0001
HEIGHT*CONTROL	5	830.64070216	4.07	0.0094	830.64070216	4.07	0.0094

STATISTICAL ANALYSIS SYSTEM Tuesday, April 20, 1978 30

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLES: LIF\_LOG

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	11	2.4034167	0.21849015	5.01	0.0001	0.027716	599.7709
ERROR	1152	93.3527276	0.0807885		STD DEV		LIF_LOG MEAN
CORRECTED TOTAL	1163	95.7561443			0.2176741		0.02675111

SOURCE	DF	TYPE I SS	F VALUE	PR > F	TYPE IV SS	F VALUE	PR > F
HEIGHT	5	1.46744266	6.21	0.0001	0.0445070	4.95	0.0117
CONTROL	1	0.44368997	9.28	0.0022	0.44368997	9.28	0.0022
HEIGHT*CONTROL	5	0.49242926	2.25	0.0173	0.49242926	2.93	0.0173

STATISTICAL ANALYSIS SYSTEM 13:12 THURSDAY, APRIL 24, 1976 39

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: MEL_LOG											
SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	TYPE III SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE
MODEL	11	215.9866394	19.63509572	33.93	0.0001	166.4346739	57.53	0.0001	5	63.28406141	21.87
ERROR	1932	1117.8872053	0.57861657		0.0001	40.94684235	70.77	0.0001	1	40.94684235	70.77
CORRECTED TOTAL	1943	1333.8738447				8.60473420	2.97	0.0112	5	8.60473420	2.97
SOURCE	DF										
HEIGHT	5										
CONTROL	1										
HEIGHT*CONTROL	5										

WEL\_LOG MEAN  
0.33061297



GENERAL LINEAR MODELS PROCEDURE

DUJACEN'S MULTIPLE RANGE TEST FOR VARIABLE CUL

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=1952 F=1109.73

GROUPING	MEAN	N	HEIGHT
A	217.77778	324	5
B	187.20000	324	6
C	159.27778	324	9
D	105.62500	324	12
E	26.33333	324	24
F	9.62500	324	36

GENERAL LINEAR MODELS PROCEDURE  
DUCCAN'S MULTIPLE RANGE TEST FOR VARIABLE CRAW

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=1932 PS=19.8147

GROUPING	MEAN	N	HEIGHT
A	1.104935	524	5
B	1.018519	524	9
B	0.947531	324	7
D	0.283951	324	30
D	0.240741	324	12
D	0.195185	324	24

GENERAL LINEAR MODELS PROCEDURE  
DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE SUR

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=1907 F=34.2264

GROUPING	MEAN	DF	HEIGHT
A	25.194644	324	4
B	8.799363	324	6
B	8.064815	324	9
C	2.018519	324	12
C	1.475209	324	26
C	0.614198	324	24

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE LFI

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=1932 P<0.0001

GROUPING	MEAN	N	HEIGHT
A	0.151235	324	12
A	0.161975	324	6
A	0.132716	324	3
A	0.077160	324	9
A	0.006173	324	24
A	0.006173	324	36



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# STATISTICAL ANALYSIS SYSTEM

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE MEL

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=1982 MS=41.4111

GROUPING	MEAN	N	HEIGHT
A	4.864105	324	5
B	3.209383	324	6
C	1.601354	324	9
D	0.373457	324	12
D	0.264827	324	24
D	0.062593	324	26

STATISTICAL ANALYSIS SYSTEM 13:02 THURSDAY, APRIL 20, 1978 45

GENERAL LINEAR MODEL PROCEDURE

POSCAN'S MULTIPLE RANGE TEST FOR VARIABLE LIT\_LOG

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=0.05		DE=1942		PS=067785	
GROUPING		MEAN	N	HEIGHT	
A	3	0.076479	524	0	
A	3	0.076479	524	8	
A	3	0.038249	324	32	
A	3	0.038249	324	9	
B	3	0.003391	324	24	
B	3	0.003391	324	46	

STATISTICAL ANALYSIS SYSTEM

GENERAL LINEAR MODELS PROCEDURE

GUANO'S MULTIPLE RANGE TEST FOR VARIABLE WEL\_LOG

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL = .05 DF = 1934 F = 0.576617

GROUPING	MEAN	N	HEIGHT
A	0.805374	324	5
B	0.615666	324	6
C	0.345638	324	9
D	0.124502	324	12
D	0.061702	324	24
D	0.027998	324	36

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE CUL

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=1032 PS=3109.71

GROUPING	MEAN	N	CONTROL
A	108.95833	216	1
B	108.72858	1728	0



STATISTICAL ANALYSIS SYSTEM 13502 THURSDAY, APRIL 26, 1978 46

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE CRAM

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=1022 P=510.5161

GROUPING	MEAN	N	CONTROL
A	2.810026	216	1
B	0.273796	1728	0

STATISTICAL ANALYSIS SYSTEM 15:17 THURSDAY, APRIL 21, 1978 49

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE MUR

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=1932 PS=363.234

GROUPING	MEAN	N	CONTROL
A	6.657407	216	1
A	7.074074	1728	0

STATISTICAL ANALYSIS SYSTEM 13:27 THURSDAY, APRIL 20, 1978 .51

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE LIT

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=1932 F=0.665673

GROUPING	MEAN	N	CONTROL
A	0.27314	216	1
B	0.062500	1728	9

STATISTICAL ANALYSIS SYSTEM 1500 THURSDAY, APRIL 21, 1972 51

GENERAL LINEAR MODEL PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE #11

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=1472 P=61.4111

GROUING	MEAN	N	CONTROL
A	6.509259	216	1
B	1.417245	1728	0



STATISTICAL ANALYSIS SYSTEM 13:02 THURSDAY, APRIL 20, 1978 50

GENERAL LINEAR MODEL PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE LIT\_LOU

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=192 MS=.047745

GROUPING	MEAN	N	CONTROL
A	0.00078	216	1
B	0.030010	1728	0

STATISTICAL ANALYSIS SYSTEM 12:02 THURSDAY, APRIL 20, 1978 53

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE PFL\_106

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=1872 MS=0.574617

GROUPING	MEAN	N	CONTROL
A	0.740507	216	1
B	0.278701	1726	6

GENERAL LINEAR MODEL PROCEDURE

CLASS									
HEIGHT	CONTROL	N	CUL	CRAB	POP	LIT	WIL	LIT_100	WIL_100
3	2	200	236.47222	5.37251667	24.115278	0.1426111	4.57000111	0.0756456	0.27333615
3	1	30	237.22222	5.56111111	16.7777778	0.1555556	7.17888889	0.0581701	1.76376278
5	2	200	134.77778	1.7305556	5.0756664	0.1388889	2.8715778	0.0674533	0.26672005
5	1	30	136.22222	2.61111111	7.5555556	0.1666667	6.27222222	0.0555312	0.2175520
6	2	200	147.97594	3.4716667	7.4618056	0.1416667	0.88196444	0.0186616	0.4866235
6	1	30	143.69444	5.5555556	12.8888889	0.1711111	2.1666667	0.1446116	1.1715128
8	2	200	50.77778	3.0722222	1.260556	0.15200333	0.1701589	0.0254768	0.0713258
8	1	30	408.41667	1.5855556	3.2222222	0.54444444	2.00000000	0.1562255	0.5499336
14	2	200	7.40333	0.0188889	0.0104167	0.0000000	0.00000000	0.0000000	0.0000000
24	2	30	179.19444	1.5555556	5.4444444	0.1555556	2.19444444	0.03051701	0.54900197
24	1	30	0.78422	5.0000000	0.0000000	0.0000000	0.00000000	0.0000000	0.0000000
25	2	20	0.68089	2.5555556	0.2222222	0.1555556	0.85333333	0.04051701	0.25107885

PART 3

A60



STATISTICAL ANALYSIS SYSTEM 1:50 THURSDAY, OCTOBER 20, 1971

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
CONT2	2	0 1

NUMBER OF OBSERVATIONS IN DATA SET = 1936

NOTE: ALL DEPENDENT VARIABLES ARE CONSISTENT WITH RESPECT TO THE PRESENCE OR ABSENCE OF MISSING VALUES. HOWEVER, ONLY 1972 OBSERVATIONS IN DATA SET CAN BE USED IN THIS ANALYSIS.

7:50 THURSDAY, DECEMBER 22, 1977

# STATISTICAL ANALYSIS SYSTEM

## GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: CUL											
SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.				
MODEL	1	167484.09368739	167484.09368739	16.81	0.0001	0.008451	85.2891				
ERROR	1970	19461622.21868584	10082.04173537				CUL MEAN				
CORRECTED TOTAL	1971	20331106.31237323					117.72816473				
SOURCE	DF	TYPE I SS	F VALUE	PR > F	TYPE IV SS	F VALUE	PR > F				
CONTR	1	167484.09368739	16.81	0.0001	169484.09368739	16.81	0.0001				

AD-A063 366

GEORGIA UNIV BRUNSWICK MARINE EXTENSION SERVICE  
THE EFFECTS OF SMOTHERING A 'SPARTINA ALTERNIFLORA' SALT MARSH --ETC(U)  
JUL 78 R J REIMOLD, M A HARDISKY, P C ADAMS DACW21-75-C-0074

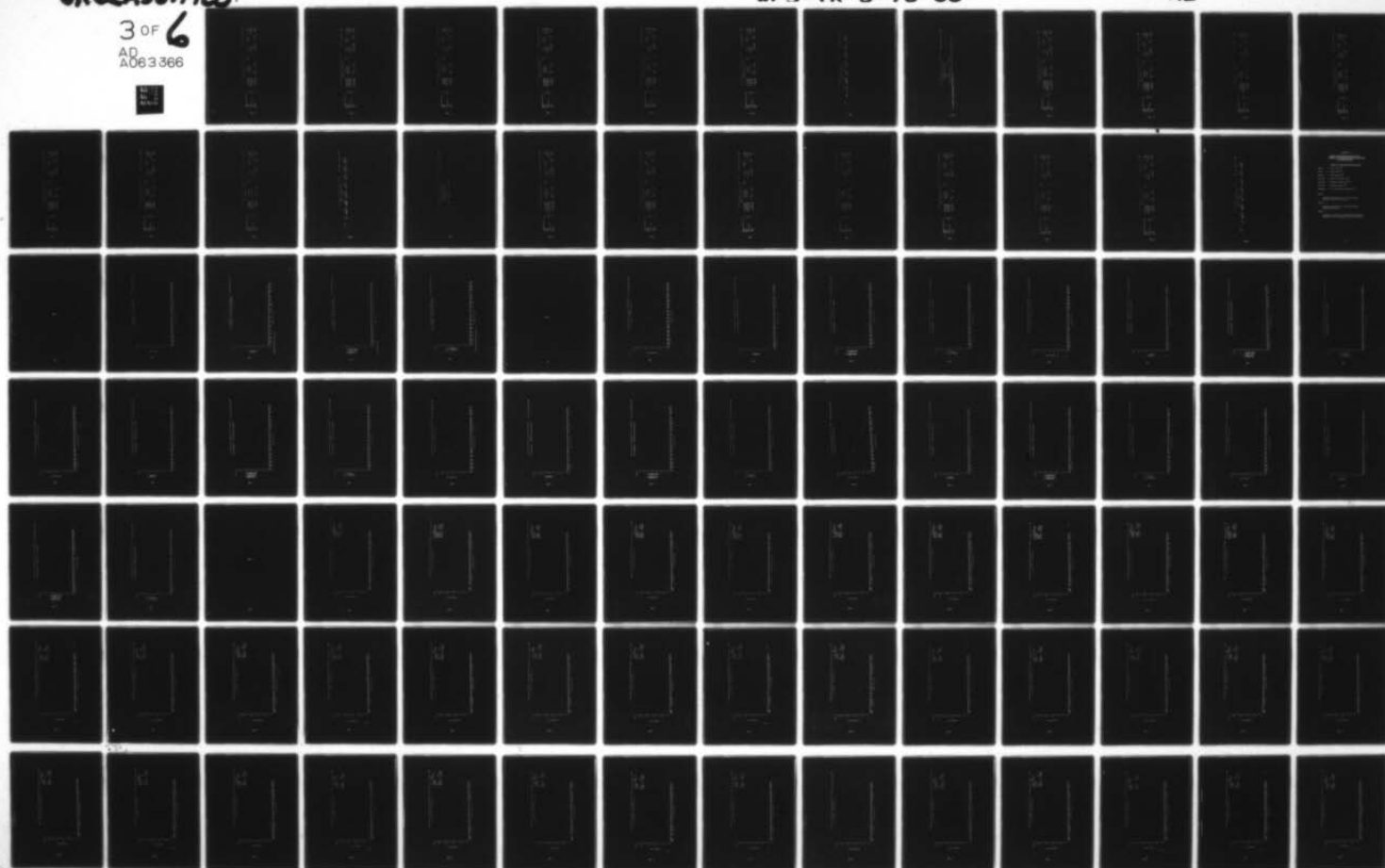
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AD  
A063 366



LAST PAGE

3 OF

6

AD

A063366





STATISTICAL ANALYSIS SYSTEM      TSPU FOUNDRY, DECEMBER 22, 1977      3

GENERAL LINEAR MODEL PROCEDURE

DEPENDENT VARIABLE: CRAB		DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	2-SIDED	C.V.
SOURCE								
MODEL		1	343.97207725	343.97207725	14.91	0.0001	0.008513	556.7380
ERROR	1973		40269.71093563	20.43538629				2943 MEAN
CORRECTED TOTAL	1971		43694.68306288					0.98732252
SOURCE		DF	TYPE I SS	F VALUE	PR > F	TYPE IV SS	F VALUE	PR > F
CONST		1	343.97207725	14.91	0.0001	343.97207725	14.91	0.0001

STATISTICAL ANALYSIS SYSTEM

7:50 THURSDAY, DECEMBER 22, 1977

GENERAL LINEAR MODEL PROCEDURE

DEPENDENT VARIABLE: A12		SUM OF SQUARES		MEAN SQUARE		F VALUE		PR > F		R-SQUARE		C.V.	
SOURCE	DF												
MODEL	1	26896.21564480		26896.21564480		65.34		0.0001		0.032101		206.5091	
ERROR	1970	813665.34368583		411.50375260				STD DEV				BUY MEAN	
CORRECTED TOTAL	1971	877551.55933063						20.24559219				7.63922637	
SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F					
CONTR	1	26896.21564480	65.34	0.0001	1	26896.21564480	65.34	0.0001					

STATISTICAL ANALYSIS SYSTEM

7:50 THURSDAY, DECEMBER 22, 1977

5

GENERAL LINEAR MODEL PROCEDURE

DEPENDENT VARIABLE: LIT		SUM OF SQUARES		MEAN SQUARE		F VALUE		PR > F		R-SQUARE		C.V.	
SOURCE	DF												
MODEL	1	10.46125844		10.46125844		15.03		0.0001		0.0772		889.3031	
ERROR	1970	1371.18326489		0.69603211				STD DEV				LIT MEAN	
CORRECTED TOTAL	1971	1381.64452333						3.8342535				3.09381339	
		TYPE I SS		F VALUE		DF		TYPE IV SS		F VALUE		PR > F	
SOURCE	DF												
CORRECT	1	10.46125844		15.03		0.0001		10.46125844		15.03		0.0001	

7:50 THURSDAY, DECEMBER 22, 1977

STATISTICAL ANALYSIS SYSTEM

GENERAL LINEAR MODEL PROCEDURE

DEPENDENT VARIABLE: MEL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.	
MODEL	1	445.58629870	445.58629870	9.93	0.0017	0.005015	383.7967	
ERROR	1970	83398.59940110	42.34254453		STD DEV		MEL MEAN	
CORRECTED TOTAL	1971	83844.58569980			6.69870051		1.73412779	
SOURCE	DF	TYP I SS	F VALUE	PR > F	DF	TYP IV SS	F VALUE	PR > F
CONTR	1	445.58629870	9.93	0.0017	1	445.58629870	9.93	0.0017



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Seneca Station 7534.17 TW254.35

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STATISTICAL ANALYSIS SYSTEM

GENERAL LINEAR MODEL PROCEDURE

DEPENDENT VARIABLE: MEL\_12

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	TYPE III SS	F VALUE	PR > F
MODEL	1	15.50829864	15.50829864	22.78	0.0001	15.50829864	22.78	0.0001
ERROR	1972	1343.65491137	0.681377					
CORRECTED TOTAL	1973	1359.16321001						
SOURCE	DF	TYPE I SS	F VALUE	PR > F	TYPE IV SS	F VALUE	PR > F	
INTER	1	15.50829864	22.78	0.0001	15.50829864	22.78	0.0001	

C.V.  
248.4438  
MEL\_12 MEAN  
0.3320236

STATISTICAL ANALYSIS SYSTEM

GENERAL LINEAR MODELS PROCEDURE

7:50 THURSDAY, DECEMBER 22, 1977

CONTR	N	CU	CRAB	ACINS	LIT	WEL	LIT_LDG	WEL_LDG
1	1948	116.690170	2.9596539	7.1791786	3.2487345	1.7366550	3.2341767	2.3223908
2	24	591.269109	4.7500000	60.8750000	3.7500000	0.0416667	3.7910245	1.1310286

STATISTICAL ANALYSIS SYSTEM 7:50 THURSDAY, DECEMBER 22, 1977

GENERAL LINEAR MODEL PROCEDURE

CLASS LEVEL INFORMATION

CLASS LEVELS VALUES

COUNTS 2 1

NUMBER OF OBSERVATIONS IN DATA SET = 1986

NOTE: ALL DEPENDENT VARIABLES ARE CONSISTENT WITH RESPECT TO THE PRESENCE OR ABSENCE OF MISSING VALUES. HOWEVER, ONLY 1982 OBSERVATIONS IN DATA SET CAN BE USED IN THIS ANALYSIS.



STATISTICAL ANALYSIS SYSTEM

1:50 THURSDAY, DECEMBER 22, 1977

GENERAL LINEAR MODEL PRICEDUJE

DEPENDENT VARIABLE: CUL		SUM OF SQUARES		MEAN SQUARE		F VALUE		PR > F		R-SQUARE		C.V.	
SOURCE	DF	1	194363.55581540	194363.55581540	19.18	19.18	0.0001	0.0001	0.0001	0.0001	0.0001	85.5730	85.5730
MODEL	195	194363.55581540	194363.55581540	19.18	19.18	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	85.5730	85.5730
ERROR	195	194363.55581540	194363.55581540	19.18	19.18	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	85.5730	85.5730
CORRECTED TOTAL	196	20023958.93378695	20023958.93378695	102.163	102.163	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	117.54230177	117.54230177
SOURCE	DF	1	194363.55581540	194363.55581540	19.18	19.18	0.0001	0.0001	0.0001	0.0001	0.0001	85.5730	85.5730
ADJUST	1	194363.55581540	194363.55581540	19.18	19.18	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	85.5730	85.5730

7:50 THURSDAY, DECEMBER 22, 1977

# STATISTICAL ANALYSIS SYSTEM

## GENERAL LINEAR MODEL PROCEDURE

DEPENDENT VARIABLE: CRR		OF		MEAN SQUARE		F VALUE		PR > F		TYPE IV SS		F VALUE		PR > F		C.V.	
SOURCE	DF	SUM OF SQUARES		91.02703680		91.02703680		0.0339		91.02703680		0.0339		0.0339		469.6065	
MODEL	1	37631.71019563		20.23495648		20.23495648										0.0339	
ERROR	1961	37692.73802243														0.0339	
CORRECTED TOTAL	1961															0.0339	
SOURCE	OF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F									
CNT3	1	91.02703680	4.51	0.0339	1	91.02703680	4.51	0.0339									

STATISTICAL ANALYSIS SYSTEM

7:50 THURSDAY, DECEMBER 21, 1977

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GENERAL LINEAR MODELING PROCEDURE

DEPENDENT VARIABLE: SUP		SUM OF SQUARES		MEAN SQUARE		F VALUE		PR > F		C.V.	
SOURCE	DF										
MODEL	1	1111.8606064		1111.8606064		2.48		0.001		272.7325	
ERROR	1963	757926.43257155		386.6451866						608.0748	
CORRECTION TOTAL	1964	759038.29317798								7.26290654	
SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F			
CONST	1	1111.8606064	2.48	0.001	1	1111.8606064	2.48	0.001			

STATISTICAL ANALYSIS SYSTEM  
 GENERAL LINEAR MODELS PROCEDURE  
 1960 THURSDAY, DECEMBER 22, 1977

DEPENDENT VARIABLE: LIT									
SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.		
MODEL	1	0.22972477	0.22972477	0.35	0.5549	0.000170	936.6815		
ERRR	1960	1291.04043774	0.65869400		STU DEV		LIT MEAN		
CORRECTED TOTAL	1961	1291.27013252			0.81159971		0.0006628		
SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F	
CONST	1	0.22972477	0.35	0.5549	1	0.22972477	0.35	0.5549	



7:50 THURSDAY, DECEMBER 22, 1977<sup>15</sup>

STATISTICAL ANALYSIS SYSTEM

115

GENERAL LINCOLN MODEL

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STATISTICAL ANALYSIS SYSTEM

GENERAL LINEAR MODEL PROCEDURE

THURSDAY, DECEMBER 23, 1977

DEPENDENT VARIABLE: LIT_L3							
SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	1	0.05489724	0.05489724	1.12	0.2892	0.00073	603.4018
ERROR	1460	95.72534016	0.06555486				
CORRECTED TOTAL	1461	95.78023741					
SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE
INT3	1	0.05489724	1.12	0.2892	1	0.05489724	1.12
							PR > F
							0.2892

DEPENDENT VARIABLE: WELL\_75

STATISTICS	DE	DF	SS	MS	F	P	MEAN	STD. DEV.	C.V.
TOTAL	1	1943	25.53297936	25.53297936	37.41	0.0001	269.1346	3.318731	249.1346
MODEL	1	1943	1343.26216719	1343.26216719	37.41	0.0001	269.1346	3.318731	249.1346
UNEXPLAINED	1	1943	1343.26216719	1343.26216719	37.41	0.0001	269.1346	3.318731	249.1346
TOTAL	1	1943	25.53297936	25.53297936	37.41	0.0001	269.1346	3.318731	249.1346

STATISTICAL ANALYSIS SYSTEM

GENERAL LINEAR MODEL PROCEDURE

TEST THRESHOLD: 0.05

DATE: 22. 10.77

7:50 THURSDAY, DECEMBER 22, 1977

# STATISTICAL ANALYSIS SYSTEM

## GENERAL LINEAR MODEL PROCEDURE

CONT	N	CUL	CRAH	MEANS		MEL	LIT LOG	MEL LOG
				BJP	LIT			
1	1949	116.699179	2.04080509	7.1991736	3.38572905	1.7063655	3.33617667	3.32223908
				16.1428571	3.21428571	17.2142857	3.39962103	1.57888517



7:30 THURSDAY, DECEMBER 22, 1977

STATISTICAL ANALYSIS SYSTEM

GENERAL LINEAR MODEL PROCEDURE

CLASS LEVEL INFORMATION

CLASS LEVEL VALUES

CONTROL 2 0 1

NUMBER OF OBSERVATIONS II DATA SET = 1948

STATISTICAL ANALYSIS SYSTEM

7:52 THURSDAY, DECEMBER 22, 1977

GENERAL LINEAR MODEL PROCEDURE

DEPENDENT VARIABLE: CUL		SUM OF SQUARES		MEAN SQUARE		F VALUE		PR > F		S-S QUANT		C.V.	
SOURCE	DF												
MODEL	1	1307789.5771483		1307789.5771483		137.79		0.0001		0.000126		33.4311	
ERROR	1946	1866560.14157100		960.0001225								CUL MEAN	
CORRECTED TOTAL	1947	1977279.71869594						0.4217741				116.6917864	
SOURCE	DF	TYPE I SS	F VALUE	PR > F	OF	TYPE IV SS	F VALUE	PR > F					
CORRECTED	1	1307789.5771483	137.79	0.0001	1	1307789.5771483	137.79	0.0001					

GENERAL LINEAR MODEL SUMMARY

DEPENDENT VARIABLE: CEAR		SUM OF SQUARES		MEAN SQUARE		F VALUE		PR > F		R-SQUARE		C.V.	
SOURCE	DF												
MODEL	1	818.72921491		818.72921491		41.45		0.0001		0.920858		472.2913	
ERROR	1946	38433.43177081		19.74999953				STD DEV				CEAR MEAN	
CORRECTED TOTAL	1947	39252.21098563						4.44403915				0.9404509	
SOURCE	DF	TYPE I SS		F VALUE		PR > F		TYPE IV SS		F VALUE		PR > F	
CONTROL	1	818.72921491		41.45		0.0001		818.72921491		41.45		0.0001	

STATISTICAL ANALYSIS SYSTEM

7:50 THURSDAY, DECEMBER 22, 1977

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RUP											
SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	S-SQUARE	C.V.				
MODEL	1	1324.39130785	1324.39130785	3.42	0.0645	0.001756	273.2335				
ERROR	1946	752909.32737796	386.93139903			STD DEV	RUP MEAN				
CORRECTED TOTAL	1947	754292.71868583				19.67056952	7.14917864				
SOURCE	DF	TYPE I SS	F VALUE	PR > F	TYPE IV SS	F VALUE	PR > F				
CONTROL	1	1324.39130785	3.42	0.0645	1324.39130785	3.42	0.0645				





7:50 THURSDAY, DECEMBER 22, 1977

# STATISTICAL ANALYSIS SYSTEM

## GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: MEL									
SOURCE		DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.	
MODEL		1	1066.78416365	1066.78416365	45.35	0.0001	0.922178	335.8996	
ERROR		1945	64379.25690411	43.3635812		STD DEV		MEL MEAN	
CORRECTED TOTAL		1947	66346.04106776			6.5845325		1.73636550	
SOURCE		DF	TYPE I SS	F VALUE	PR > F	TYPE IV SS	F VALUE	PR > F	
CONTROL		1	1066.78416365	45.36	0.0001	1066.78416365	45.36	0.0001	

GENERAL LINEAR MODEL PROCEDURE

DEPENDENT VARIABLE: LIT_10		SUM OF SQUARES		MEAN SQUARE		F VALUE		PR > F		TYPE III SS		F VALUE		PR > F		TOTAL		C.V.	
SOURCE	DF																		
MODEL	1	0.6296679		0.6296679		8.94		0.0028		0.6296679		8.94		0.0028		605.0636		605.0636	
ERROR	1966	93.6113560		0.0476341												LIT_10 MEAN			
CORRECTED TOTAL	1967	93.9600239								0.2192120						3.03617667			
TOTAL	1967																		
CONTROL	1	0.4296679		0.4296679		8.94		0.0028		0.4296679		8.94		0.0028					

STATISTICAL ANALYSIS SYSTEM

1950 THURSDAY, DECEMBER 22, 1977

26

GENERAL LINEAR MODEL PROCEDURE

DEPENDENT VARIABLE: HELL_10		SUM OF SQUARES		MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
SOURCE	DF							
MODEL	1	43.14368139		43.14368139	66.70	0.0001	0.333141	269.5794
ERROR	1946	1253.63350501		0.6460555				45.176 M4A
CORRECTED TOTAL	1947	1301.8271639						3.2223908
SOURCE		TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
TOTAL	1	43.14368139	66.70	0.0001	1	43.14368139	66.70	0.0001



7:50 THURSDAY, DECEMBER 22, 1977

STATISTICAL ANALYSIS SYSTEM

GENERAL LINEAR MODELS PROCEDURE

CONTROL	N	CUL	CPAS	MEANS			LIT	MEL	LIT_1	MEL_1
				3UR	3UR	3UR				
2	1770	123.437733	2.71023713	4.90572595	0.08266395	0.26540630	0.33092262	0.26927612	0.33092262	0.26927612
1	210	185.502233	2.76257108	9.31594174	0.26540630	0.26540630	0.33092262	0.26927612	0.33092262	0.26927612

## APPENDIX B

### GRAPHIC REPRESENTATION OF DEPENDENT VARIABLES FOR MARSH SMOTHERING EXPERIMENTAL AND CONTROL AREAS

#### Legend for Dependent Variable Codes

Culm_d	=	Live culms /m <sup>2</sup>
Crabs	=	Live crabs /m <sup>2</sup>
Burrows	=	Crab burrows /m <sup>2</sup>
Littorin	=	<i>Littorina irrorata</i> /m <sup>2</sup>
Melampus	=	<i>Melampus bidentatus</i> /m <sup>2</sup>
Flowerin	=	Flowering culms /m <sup>2</sup>
Seedling	=	<i>S. alterniflora</i> seedlings /m <sup>2</sup>

#### PART 1

Dependent variables for 3m x 3m enclosure  
controls versus sampling data.

#### PART 2

Dependent variables for control enclosure  
vesus sampling date.

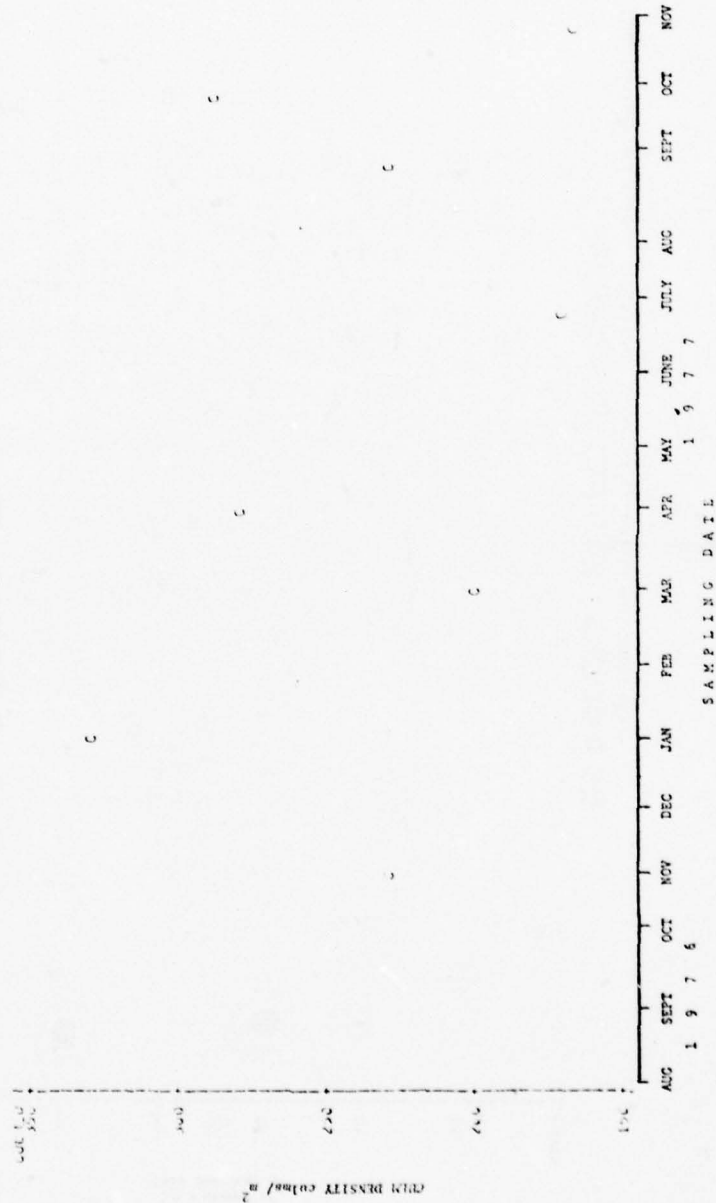
#### PART 3

Dependent variables for experimental enclosures  
by height, soil and month versus sampling date.

PART 1

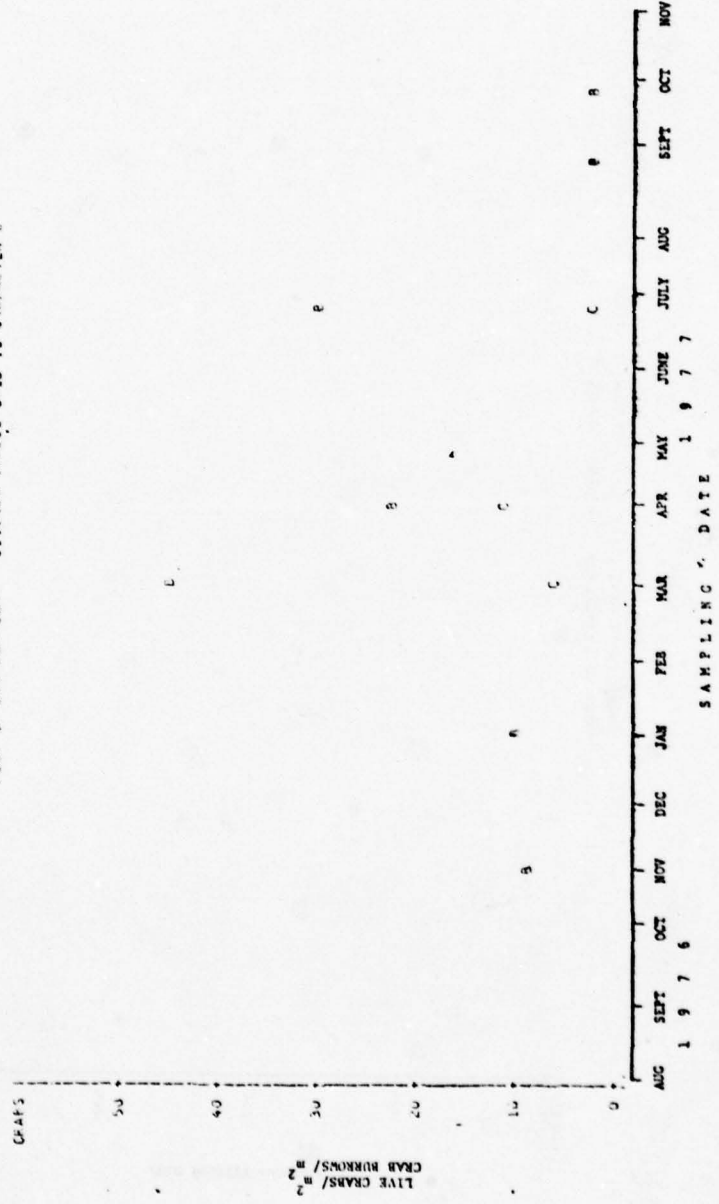
3:00 TUESDAY, DECEMBER 20, 1977

MARSH SOUTHERN LUNGS LEFT ENCLOSED CONTROLS  
 PLOT OF DAY-COL-4.0 LEGEND: SYMBOL USED IS C



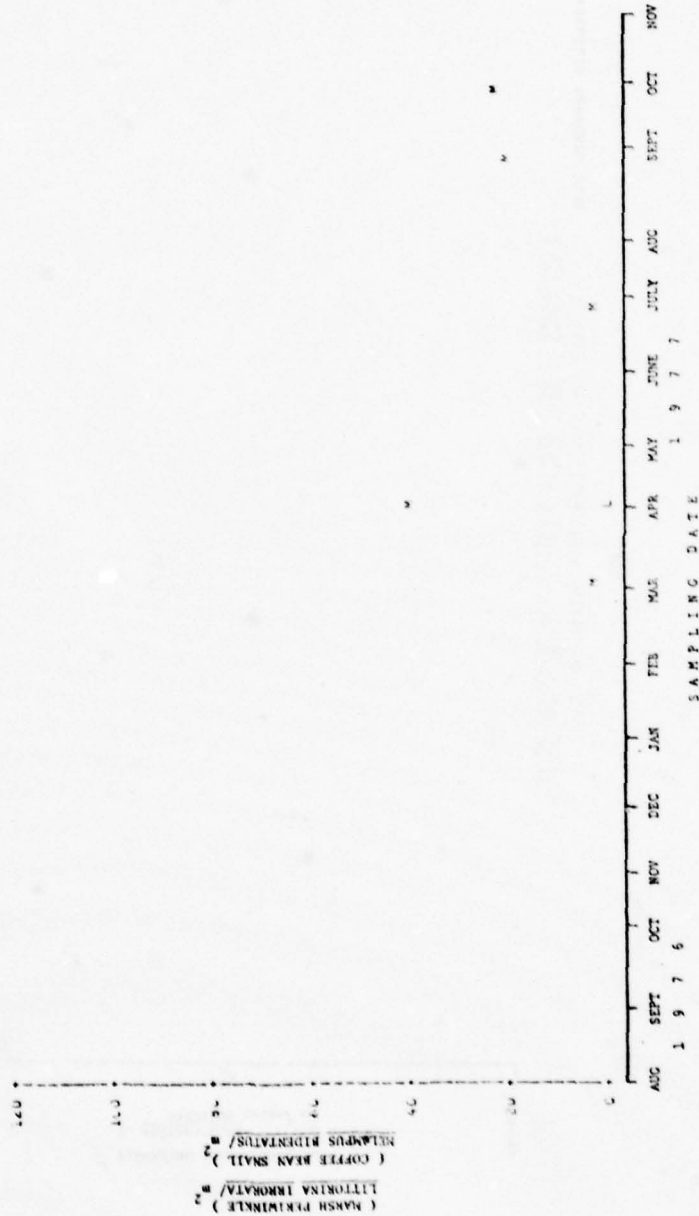


MARSH MONITORING 13x13 FEET ENCLOSURE CONTROLS  
 3:01 TUESDAY, DECEMBER 20, 1977  
 2  
 PLOT OF DAY-GRASS      LEGEND: SYMBOL USED IS CHARACTER C  
 PLOT OF DAY-SURFERS      LEGEND: SYMBOL USED IS CHARACTER B



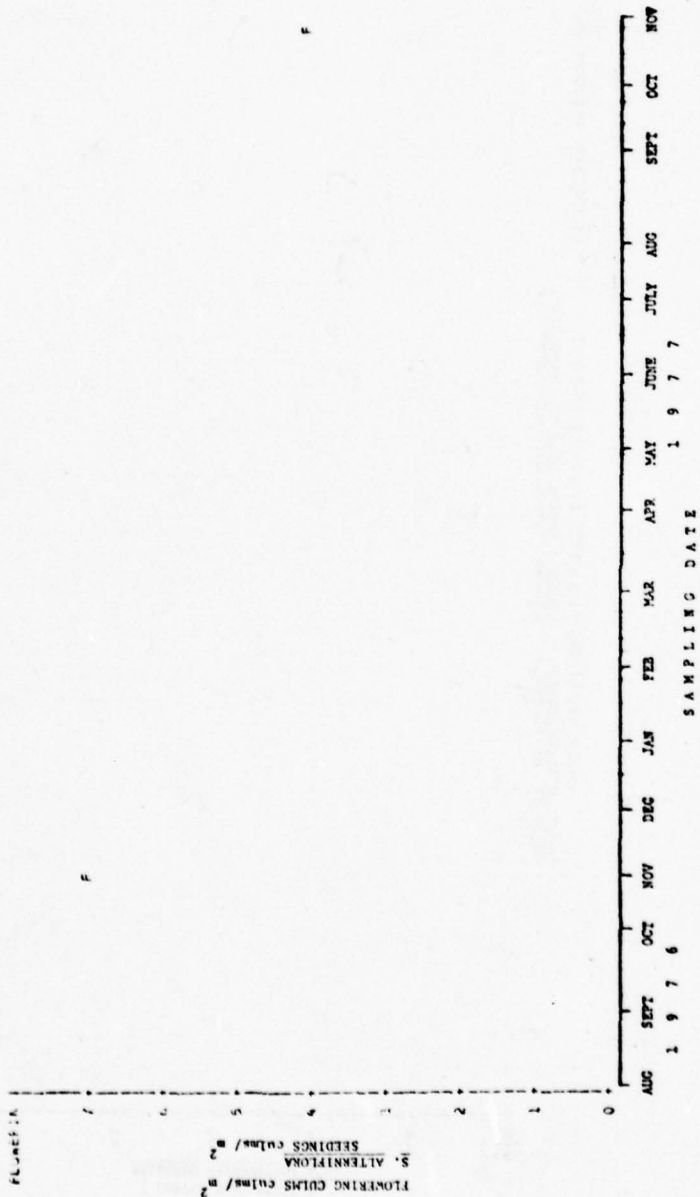
3:01 TUESDAY, DECEMBER 20, 1977 3

WASH. SACCHERING 13-10 FEET EXCLOSURE CONTROLS  
 PLT. IF DAY-RELIABLES LEGEND: SYMBOL USED IS CHARACTER L  
 PLT. IF DAY-RELIABLES



3101 TUESDAY, DECEMBER 20, 1977

MAXIMUM SPOTWEAVING 10-15 FEET ENCLOSURE CONTROLS  
 PUT OF SPOTWEAVING BECAUSE SYMBOL USED IS CHARACTER 5



PART 2

B7

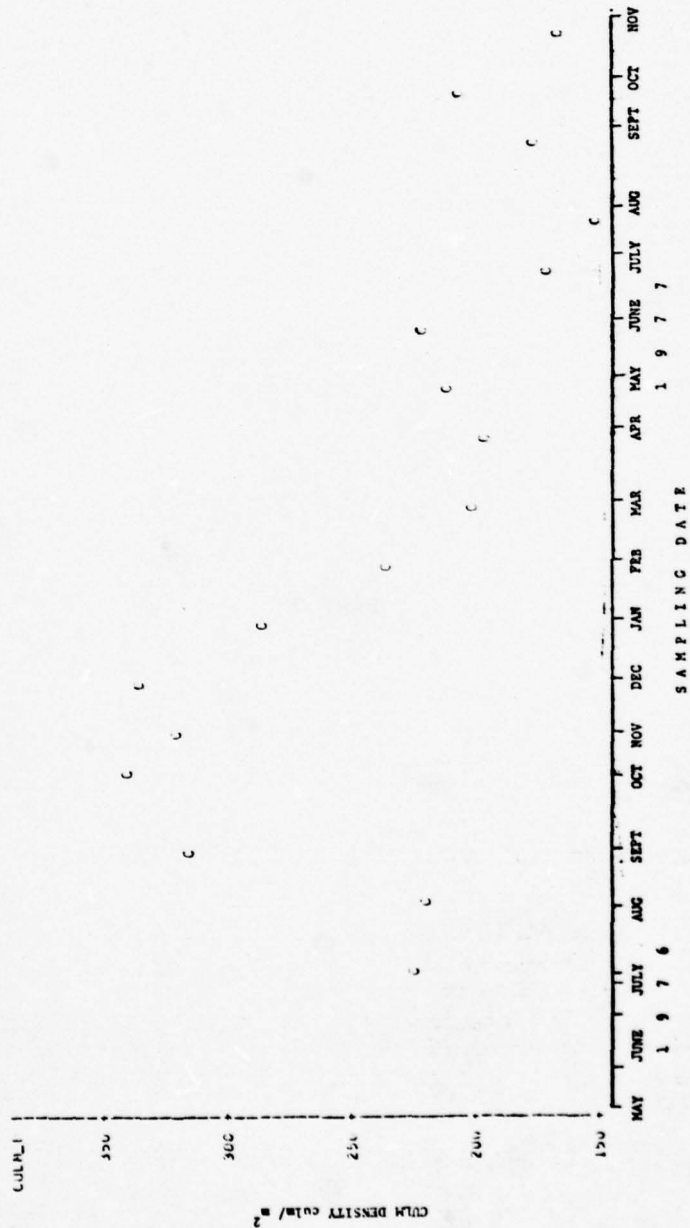


11:31 TUESDAY, DECEMBER 20, 1971

CONTROL PIPES EVALUATION AT EACH HEIGHT FOR MARSH SMOTHERING

HEIGHT=3

PLOT OF DAY\*CUML\_D LEGEND: SYMBOL USED IS C



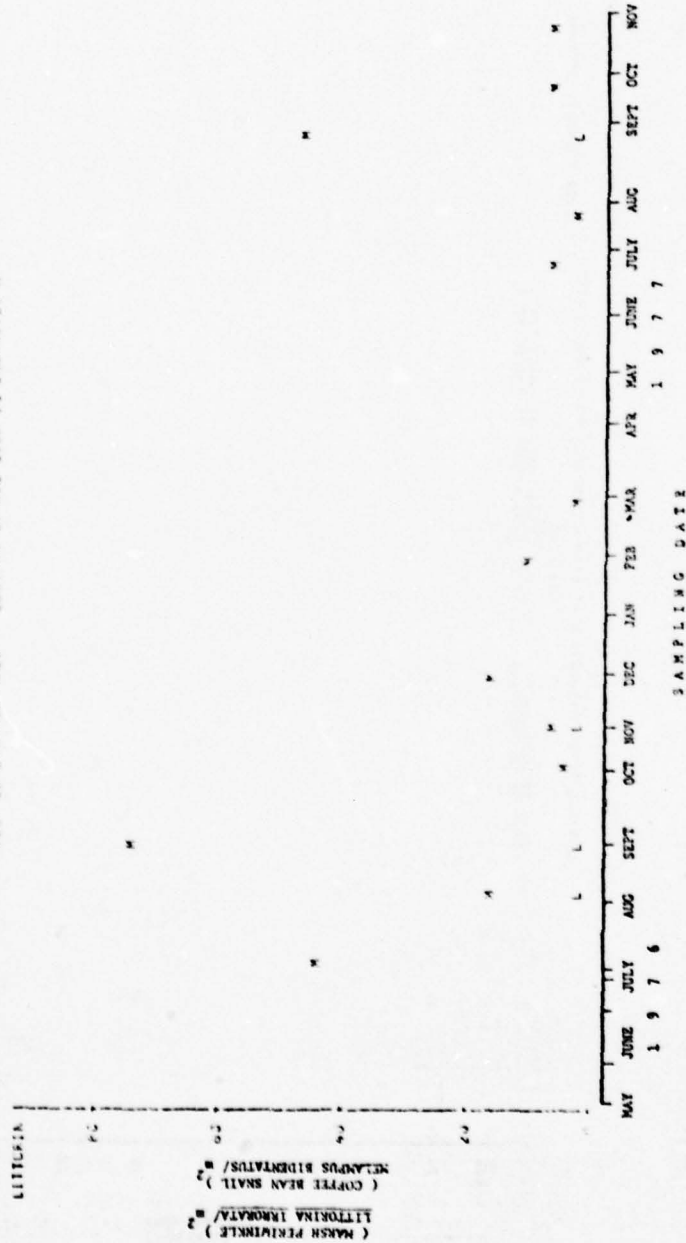


11:31 TUESDAY, DECEMBER 20, 1977

CONTROL PIPES EVALUATION AT EACH HEIGHT FOR MARSH MONITORING

HEIGHTS

PLANT OF DAYLIGHTEDEN CELESTIAL SYMBOL USED IS CHARACTER L  
CELESTIAL SYMBOL USED IS CHARACTER M

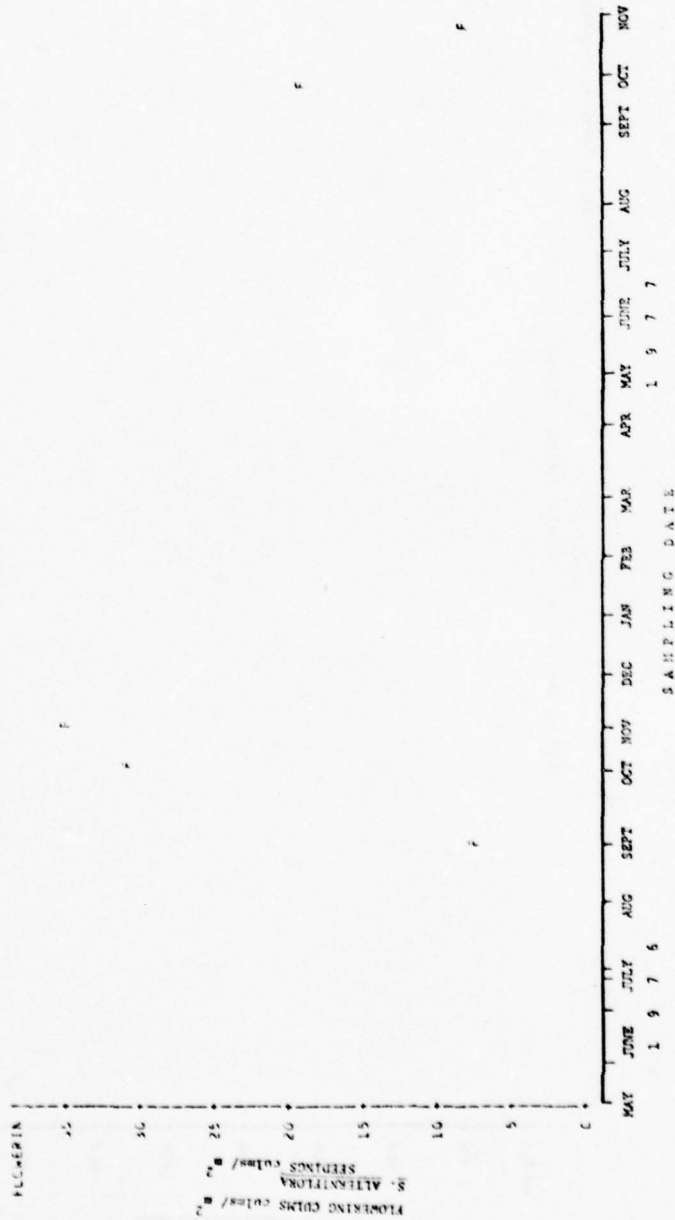


CONTROL PIPES EVALUATION AT EACH HEIGHT FOR MARCH SMOTHERING

HEIGHT: 3

11:31 TUESDAY, DECEMBER 20, 1977

PLANT OF DAY-SEEDING HEIGHT SYMBOL USED IS CHARACTER F  
PLANT OF DAY-SEEDING HEIGHT SYMBOL USED IS CHARACTER S



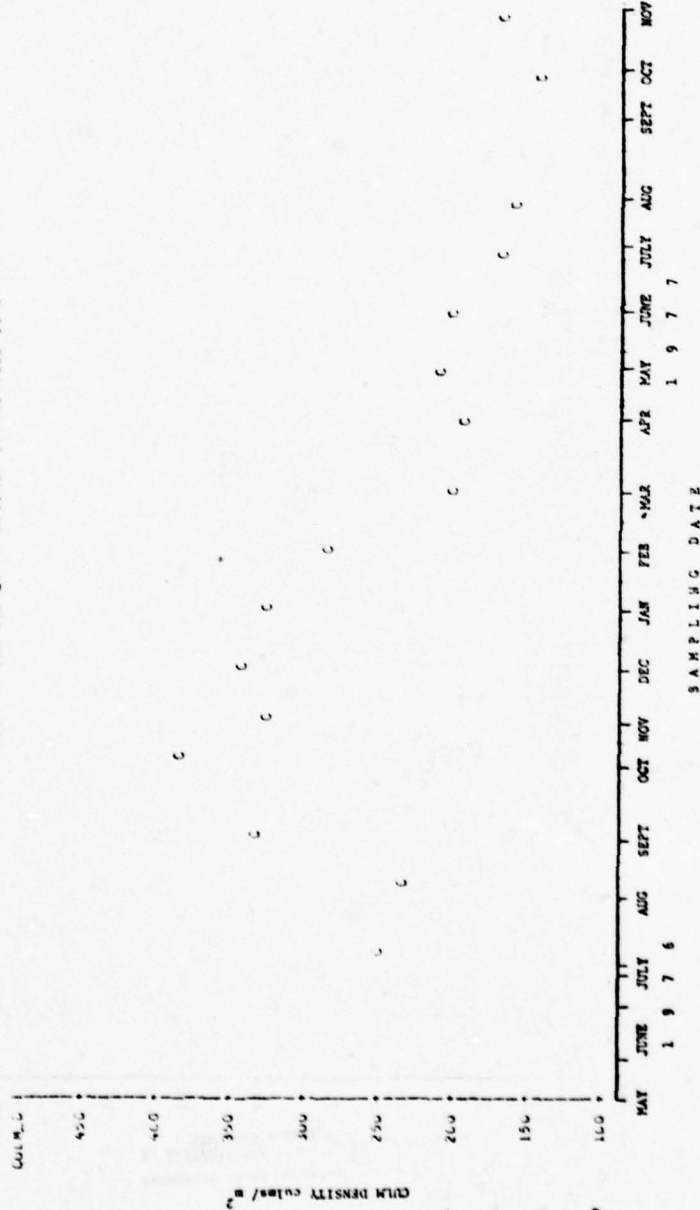


11:31 TUESDAY, DECEMBER 20, 1977

CONTROL PIPES EVALUATION AT EACH HEIGHT FOR MASS SMOOTHERING

HEIGHTS

PLOT OF DATA FOR LEGEND SYMBOL USED IS C

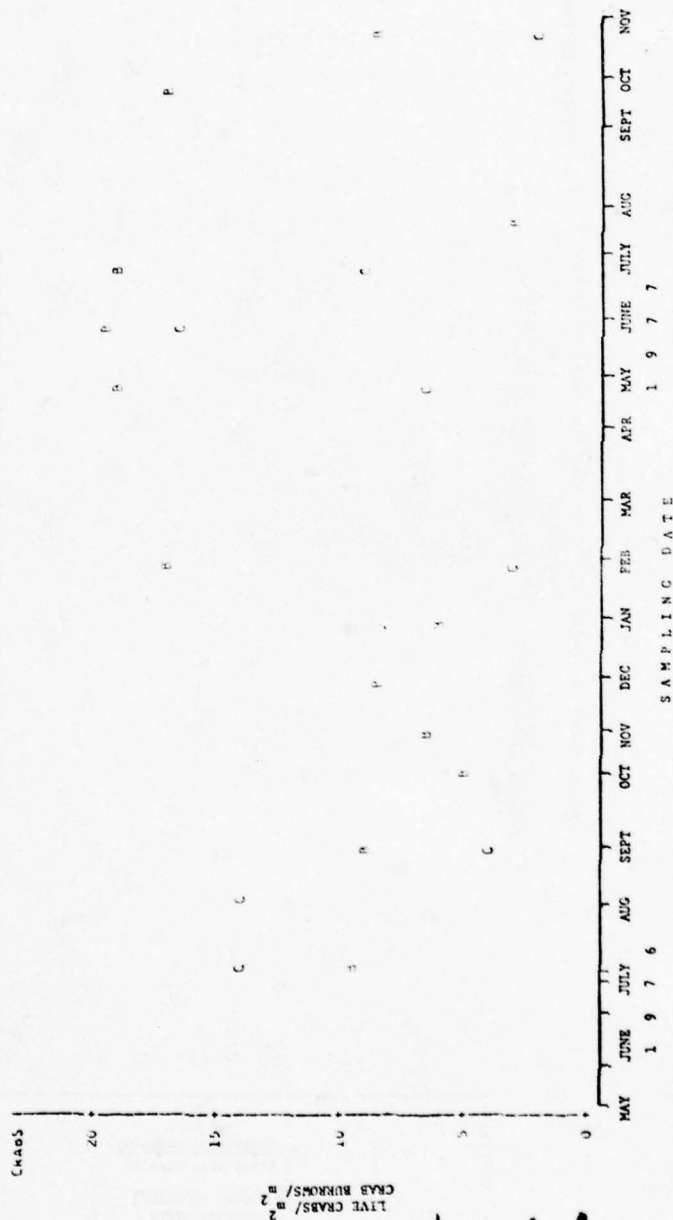


11:31 TUESDAY, DECEMBER 20, 1977

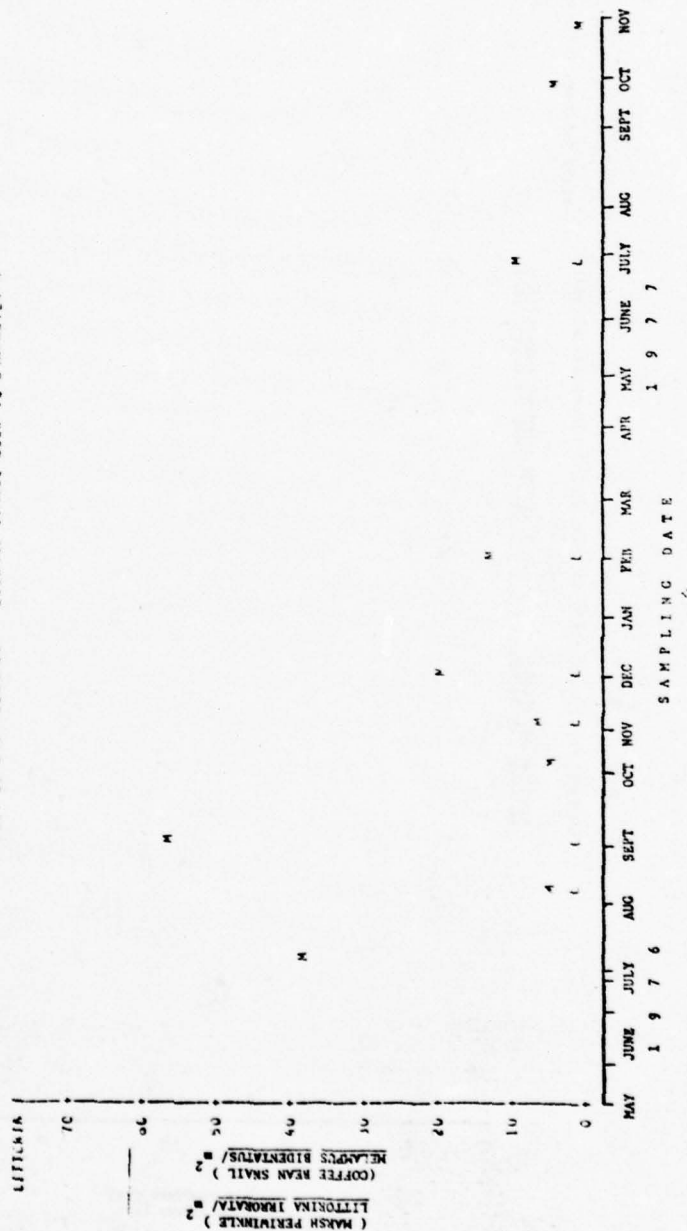
CONTROL PIPE EVALUATION AT EACH HEIGHT FOR MARSH SAMPLING

HEIGHT=6

PLT OF DAY-CRABS  
PLT OF DAY-CRABS  
LEGEND: SYMBOL USED IS CHARACTER C  
LEGEND: SYMBOL USED IS CHARACTER H



CONTACT PIPES EVALUATION AT EACH HEIGHT FOR MASSA SMOOTHERING  
 11:31 TUESDAY, DECEMBER 20, 1977

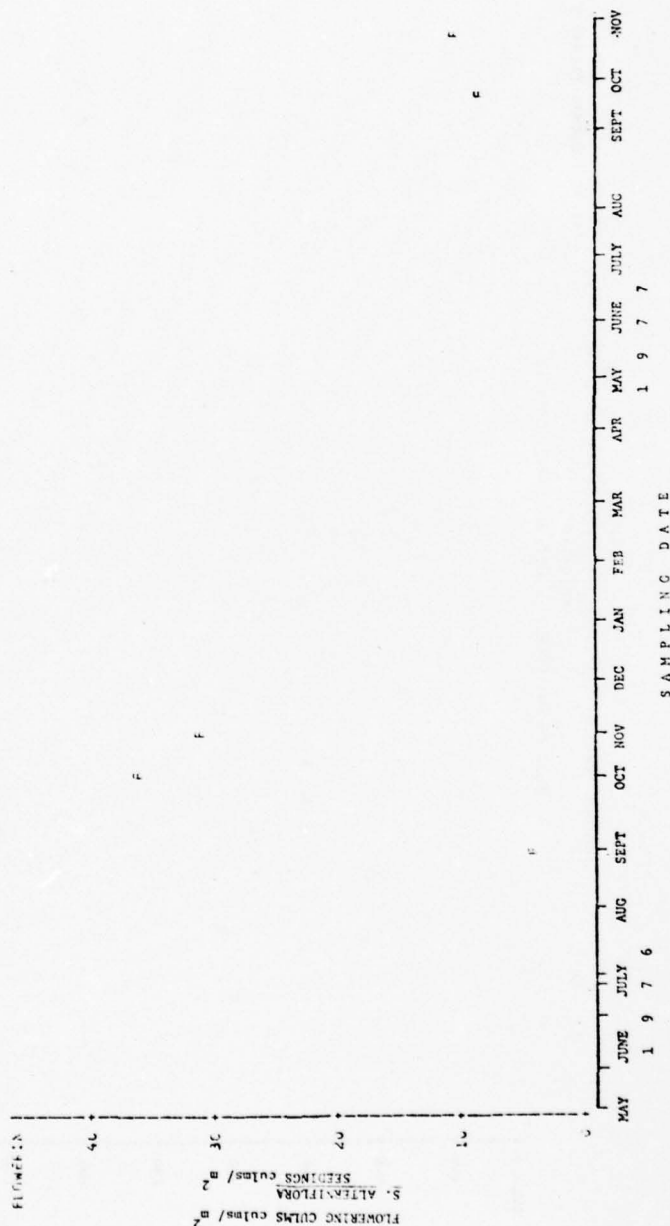


CONTROL PIPES EVALUATION AT EACH HEIGHT FOR MARSH SMOTHERING 11:31 TUESDAY, DECEMBER 20, 1977

HEIGHT = 6

PLOT OF DAY FLOWERING  
PLOT OF DAY SEEDLING

LEGEND: SYMBOL USED IS CHARACTER S  
LEGEND: SYMBOL USED IS CHARACTER S

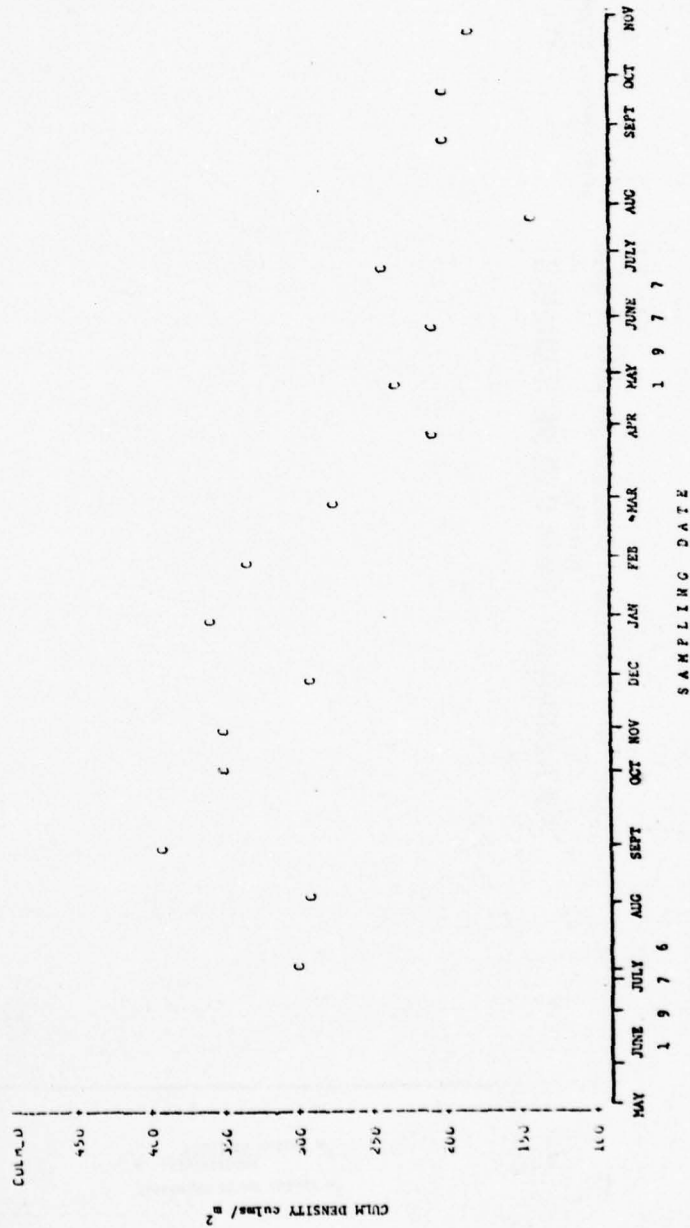


11:31 TUESDAY, DECEMBER 20, 1977

CONTROL PIPES EVALUATION AT EACH HEIGHT FOR MAPSH SMOTHERING

HEIGHT=9

PLT OF DATA(CULM\_3)      LEGEND: SYMBOL USED IS C





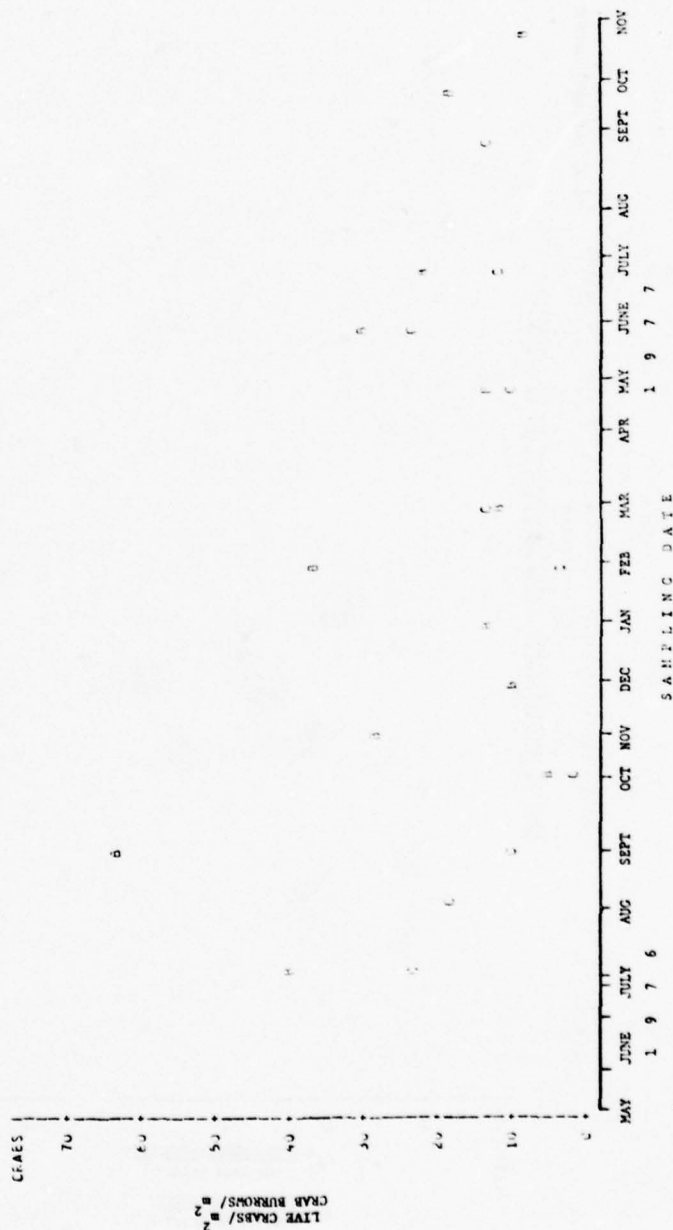
11:31 TUESDAY, DECEMBER 20, 1977

CONTROL PIPES EVALUATION AT EACH HEIGHT FOR MARSH BROTHERING

HEIGHT=9

PLT OF DRY GRASS LEGEND: SYMBOL USED IS CHARACTER C

PLT OF DRY BURROWS LEGEND: SYMBOL USED IS CHARACTER B

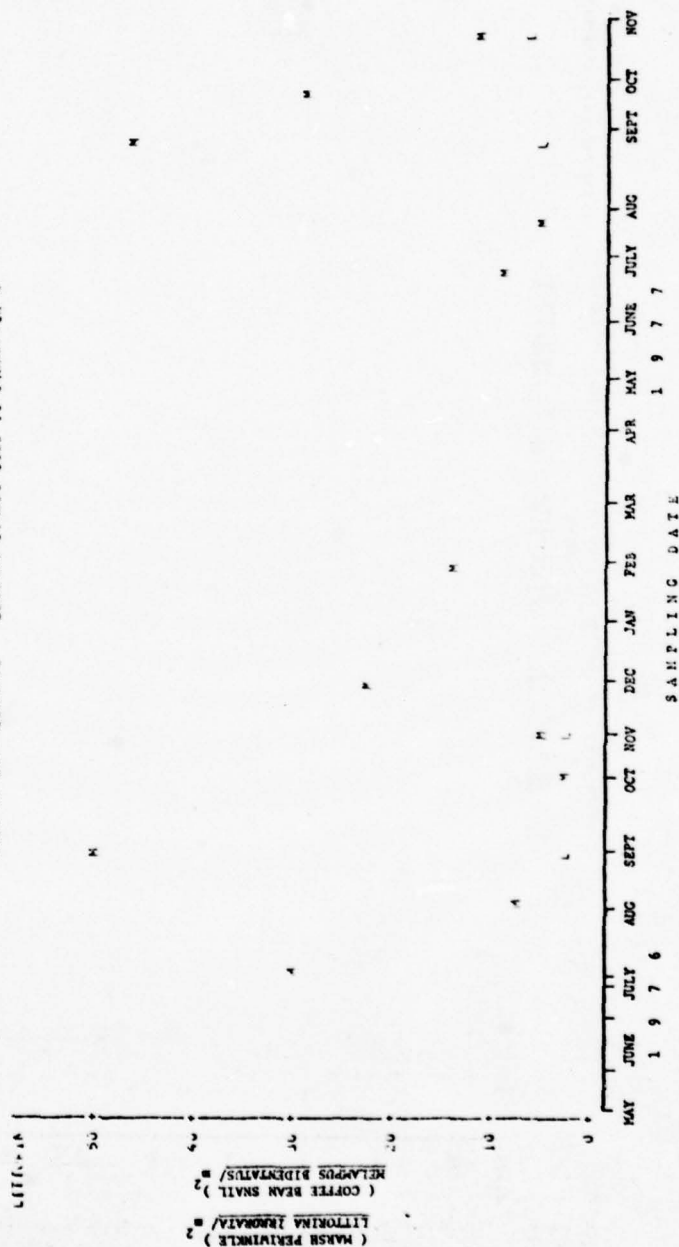


CONTROL PIPES EVALUATION AT EACH HEIGHT FOR MARSH SMOTHERING 11:31 TUESDAY, DECEMBER 20, 1977

HEIGHT=9

PLST (P) DAYLIGHT/PLST (P) NIGHT/PLST (P) USED IS CHARACTER L

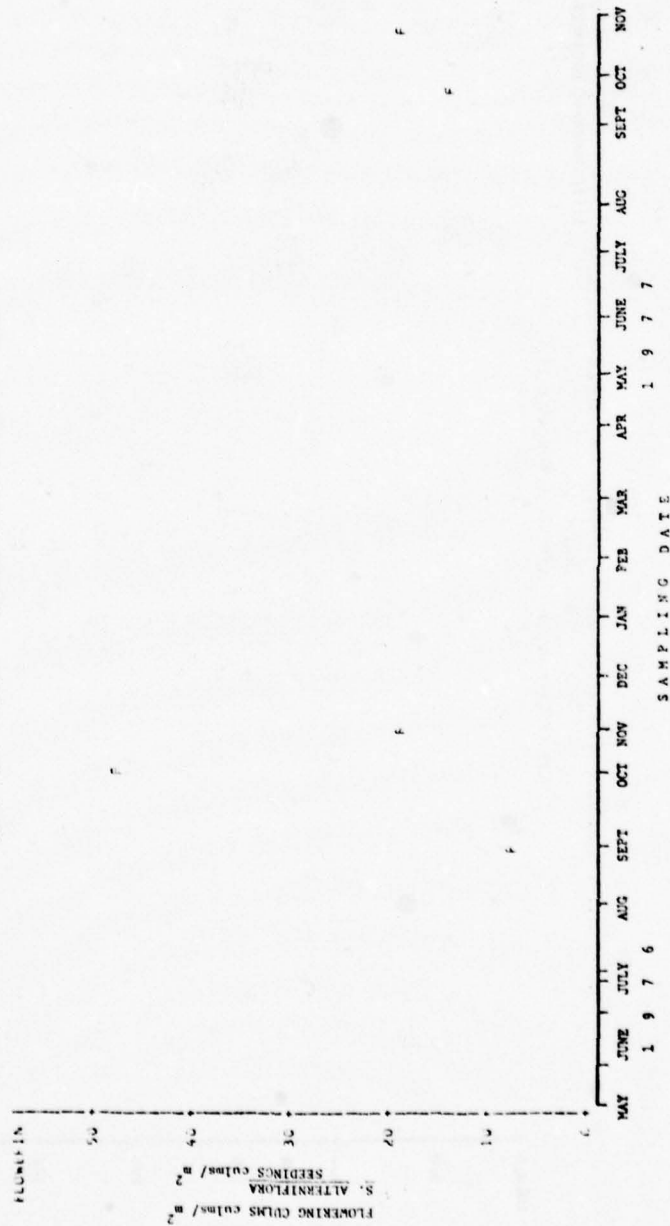
LEGEND: SYMBOL USED IS CHARACTER M



CONTROL PIPES EVALUATION AT EACH HEIGHT FOR MARSH SMOTHERING 11:11 TUESDAY, DECEMBER 20, 1977

HEIGHT=9

PLT OF DAY-FLORIN LEGEND: SYMBOL USED IS CHARACTER F  
PLT OF DAY-SEEDING LEGEND: SYMBOL USED IS CHARACTER S

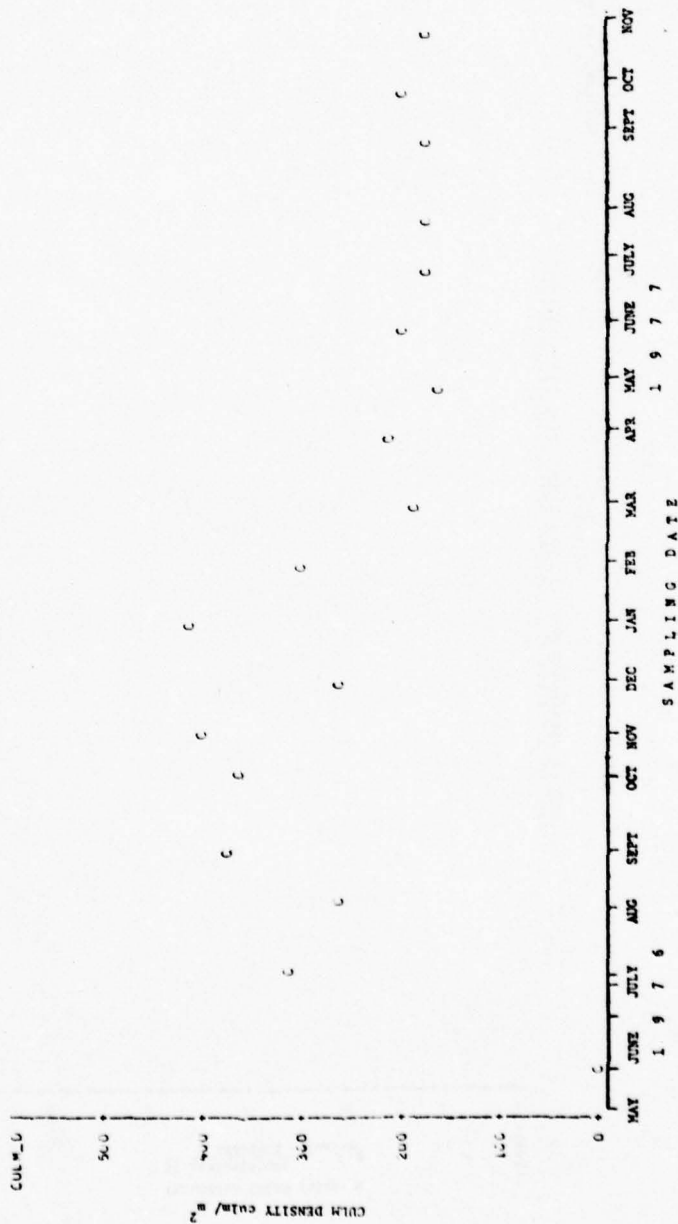


CONTROL PIPES EVALUATION AT EACH HEIGHT FOR MARSH SMOKEING 11:31 TUESDAY, DECEMBER 20, 1977

HEIGHT=12

PLAT OF DAY=CULM\_12

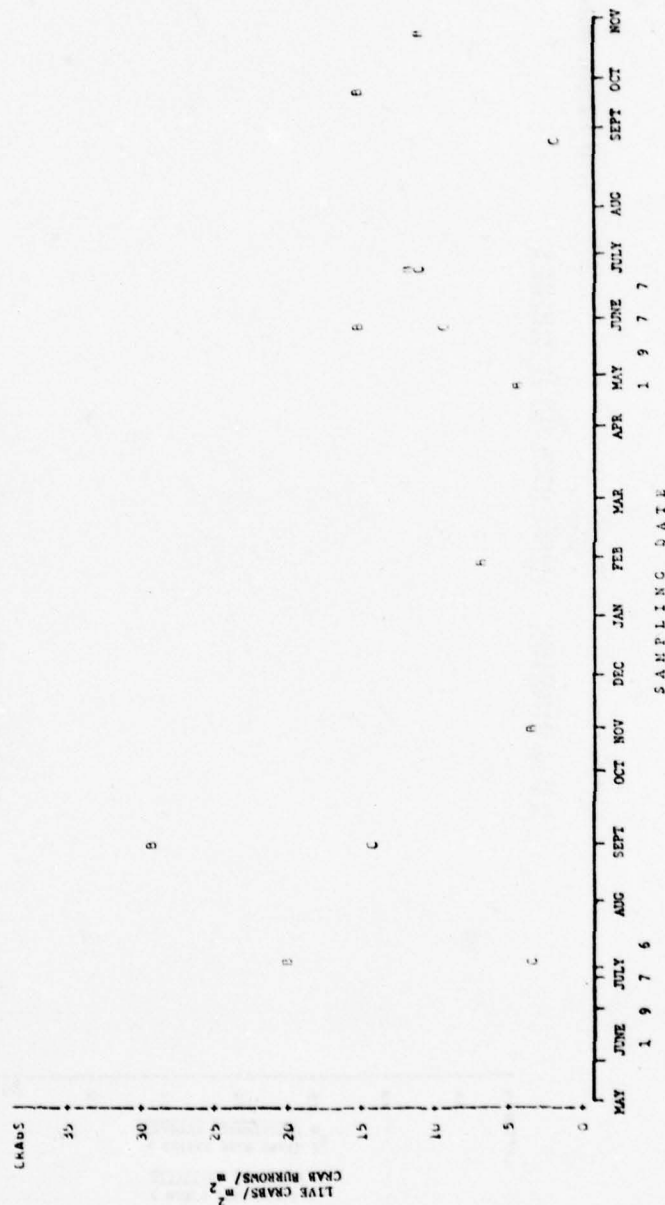
LEGEND: SYMBOL USED IS :



CONTROL PIPES EVALUATION AT EACH HEIGHT FOR MARS4 SMOOTHERING  
 11:31 TUESDAY, DECEMBER 20, 1977

HEIGHT=12

PLST OF DAY-CHARS. LEGEND: SMALL USED IS CHARACTER B



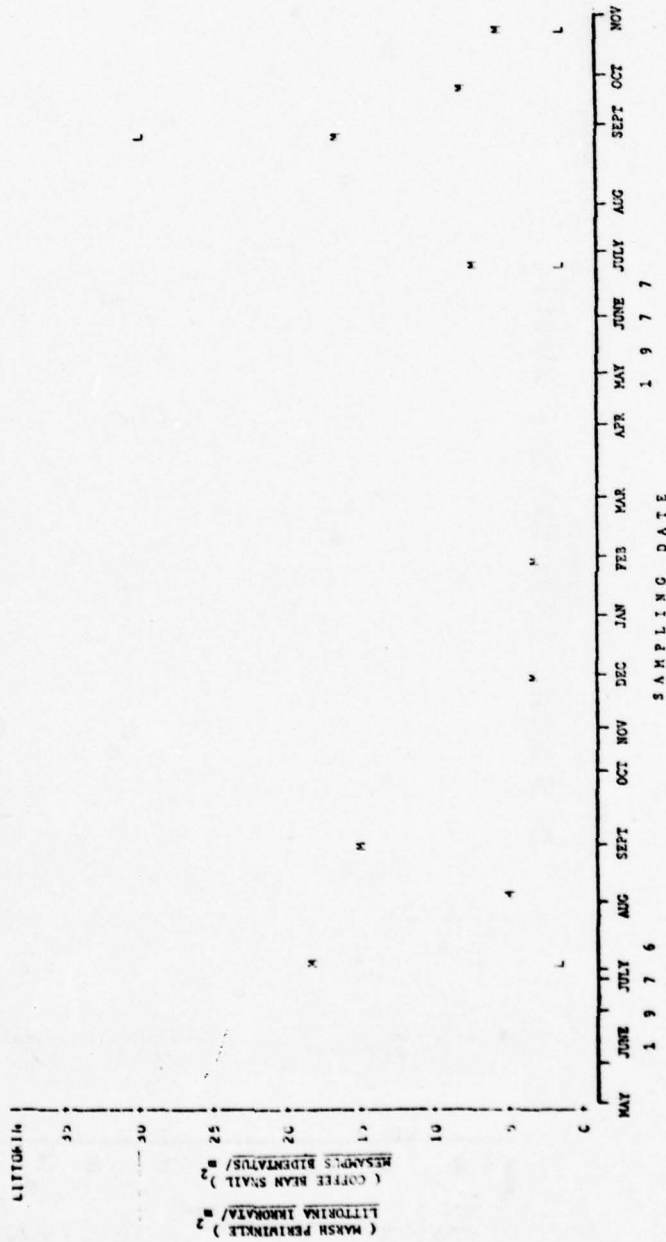


11:31 TUESDAY, DECEMBER 20, 1977

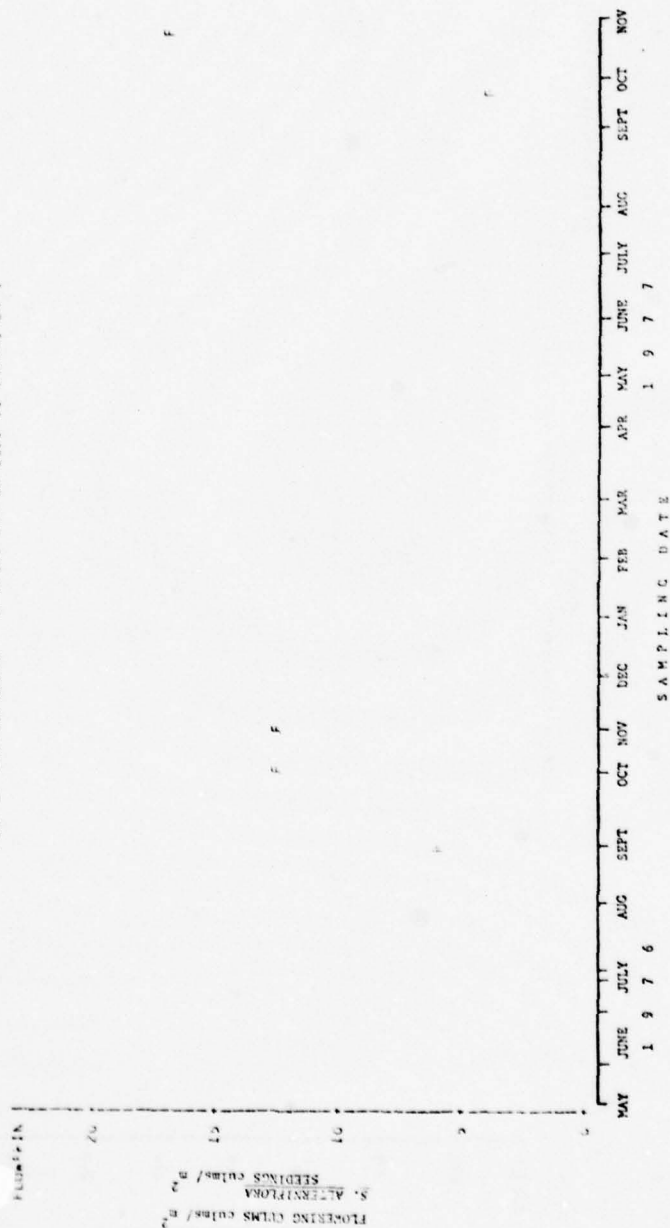
CONTROL PIPES EVALUATION AT EACH HEIGHT FOR MARSH SMOTHERING

HEIGHT=12

PLOT OF DAY=LITTORIN LEGEND: SYMBOL USED IS CHARACTER L  
PLOT OF DAY=HELANUS LEGEND: SYMBOL USED IS CHARACTER M



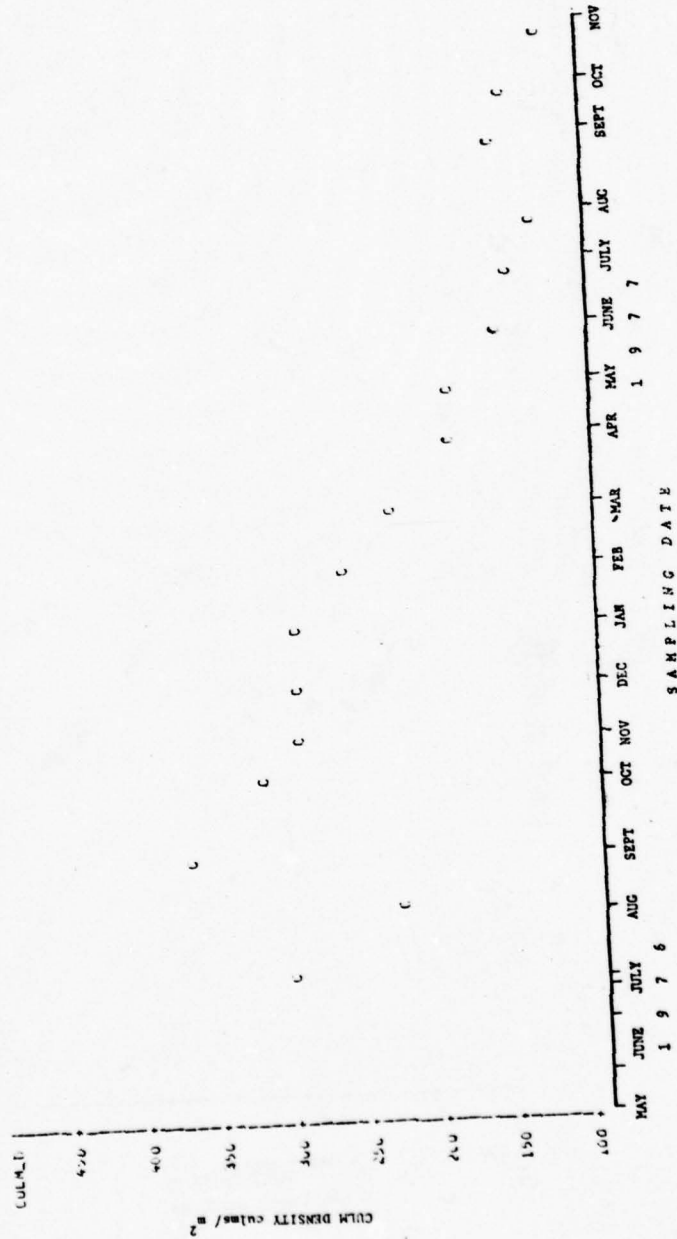
21 JAN 13  
 DISSEMINATION CENTER FOR AMERICAN ARMS AT WASHINGTON FIELD OFFICE  
 11:31 TUESDAY, DECEMBER 20, 1961



11:31 TUESDAY, DECEMBER 20, 1977

CONTROL PIPES EVALUATION AT EACH HEIGHT FOR MASH SMOTHERING  
HEIGHT=24

PLOT OF DATA CUMULATED LEGEND: SYMBOL USED IS C



B24

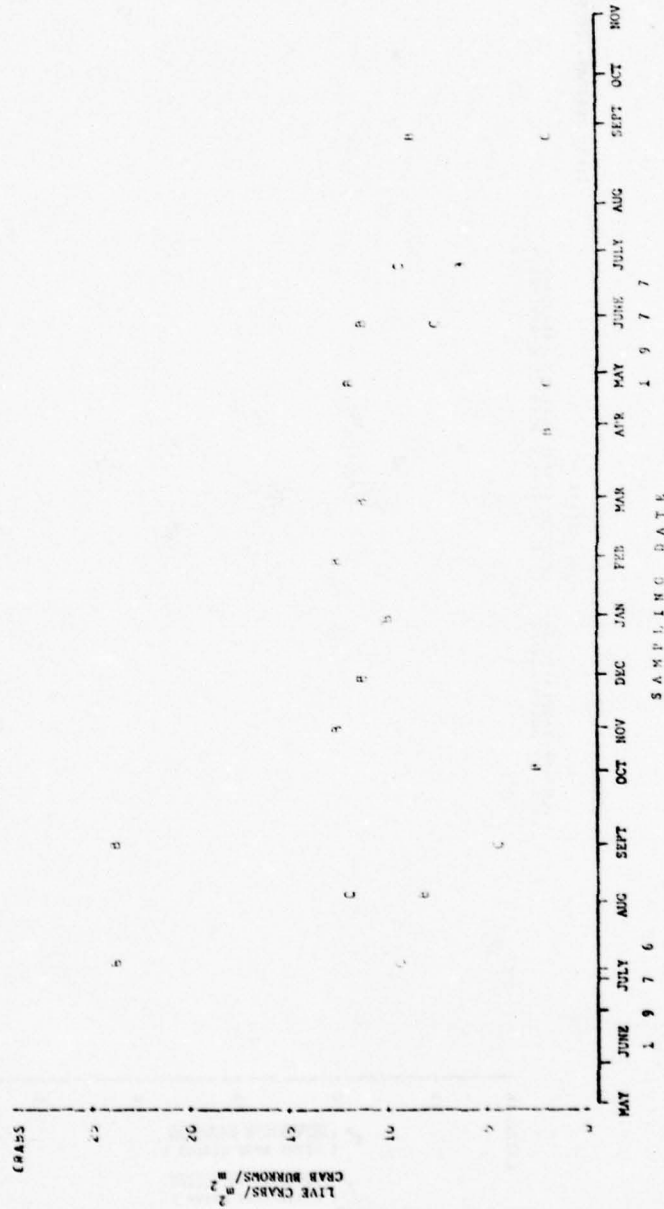
11:31 TUESDAY, DECEMBER 20, 1977

CONTROL PIPES EVALUATION AT EACH HEIGHT FOR MARSA MATRUH

HEIGHT: 24

PLOT OF DAY: 1977  
PLOT OF DAY: 1977

LEGEND: SYMBOL USED IS CHARACTER C  
LEGEND: SYMBOL USED IS CHARACTER C

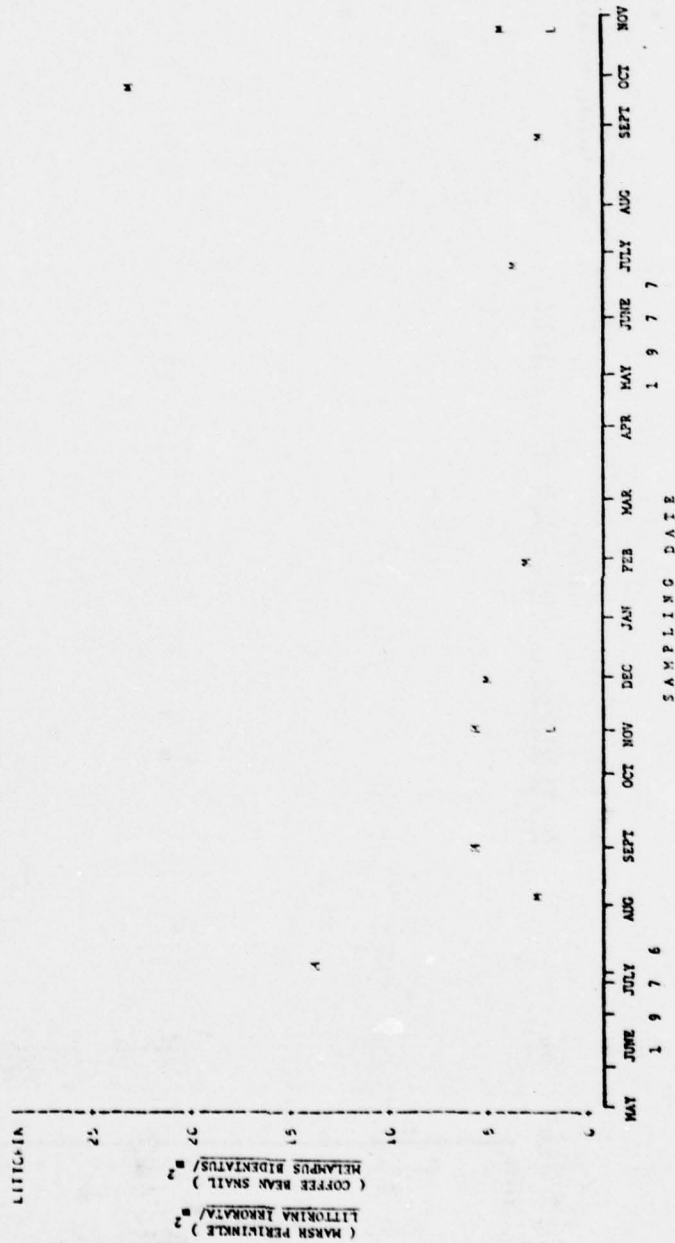


11:21 TUESDAY, DECEMBER 20, 1977

CONFOR PIPES EVALUATION AT EACH HEIGHT FOR MAPS4 SMOOTHING

HEIGHT 24

PLUT OF DAY LITTONIN LEGEND: SYMBOL USED IS CHARACTER L  
PLUT OF DAY MELAMPUS LEGEND: SYMBOL USED IS CHARACTER M

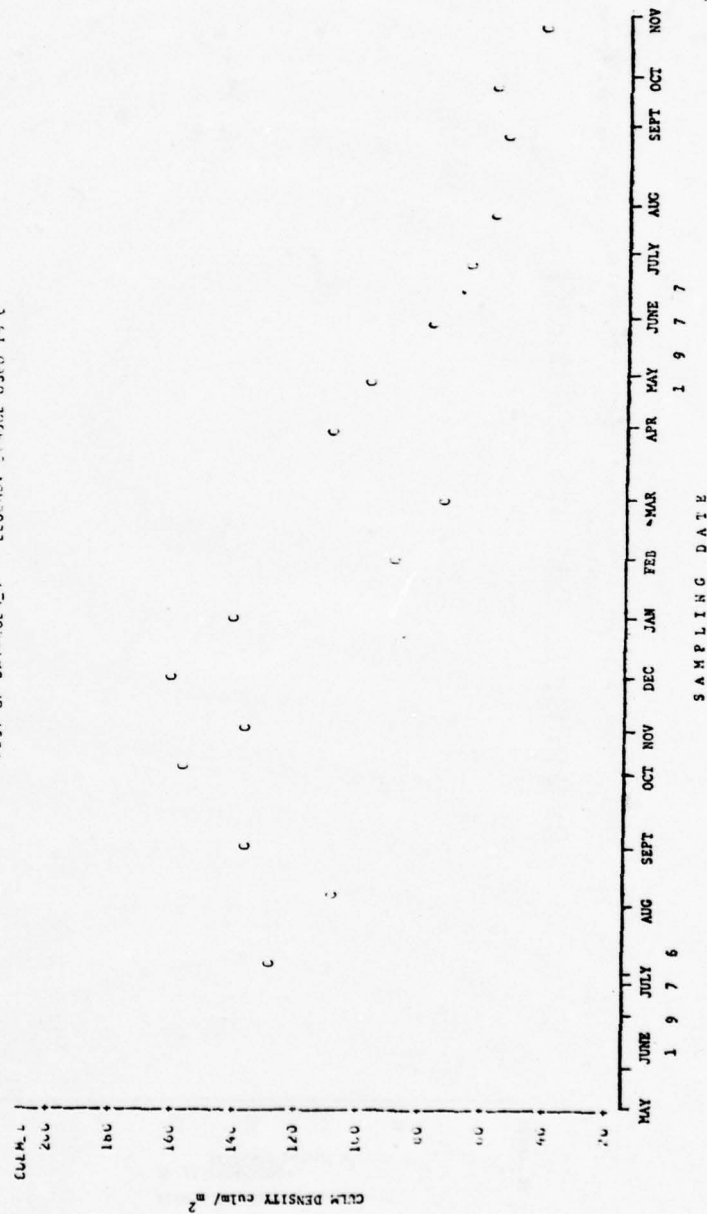






CENTRAL PIPES EVALUATION AT EACH HEIGHT FOR MARSH SMOTHERING  
 HEIGHT=30  
 PLT OF CAY-CUL-1.3 LEGEND: C=400L USED IS C

11:31 TUESDAY, DECEMBER 20, 1977



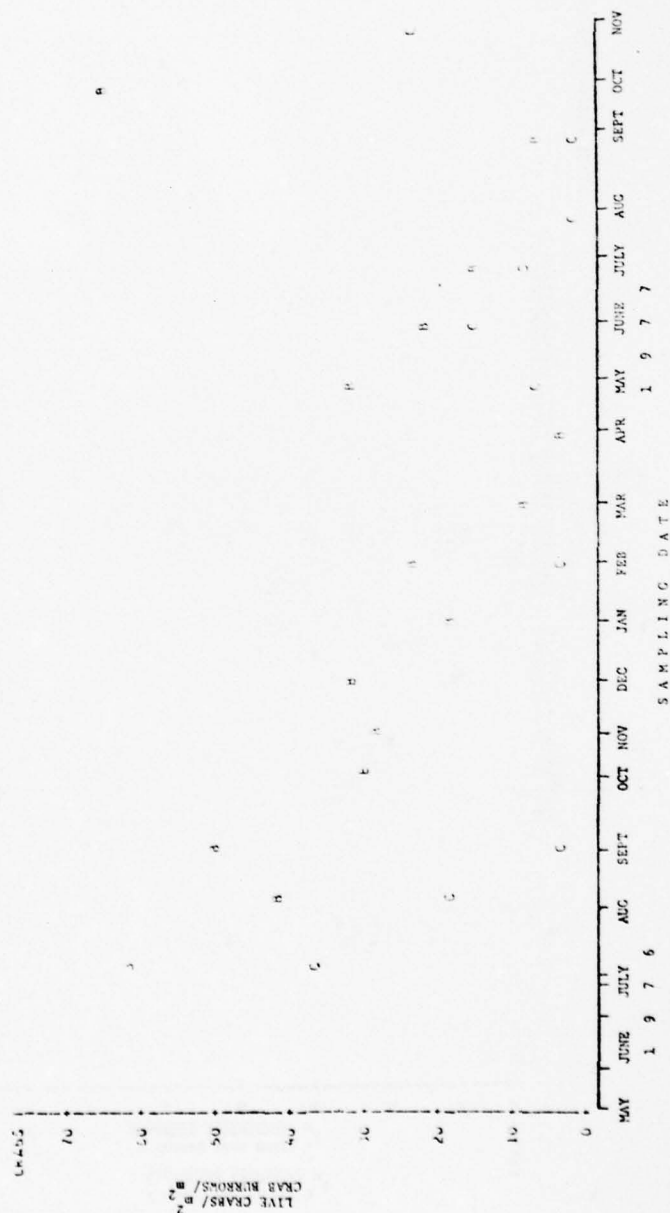
B28

11:31 TUESDAY, DECEMBER 20, 1977

CONTROL PIPE EVALUATION AT EACH HEIGHT FOR WAFSA SMOOTHERING

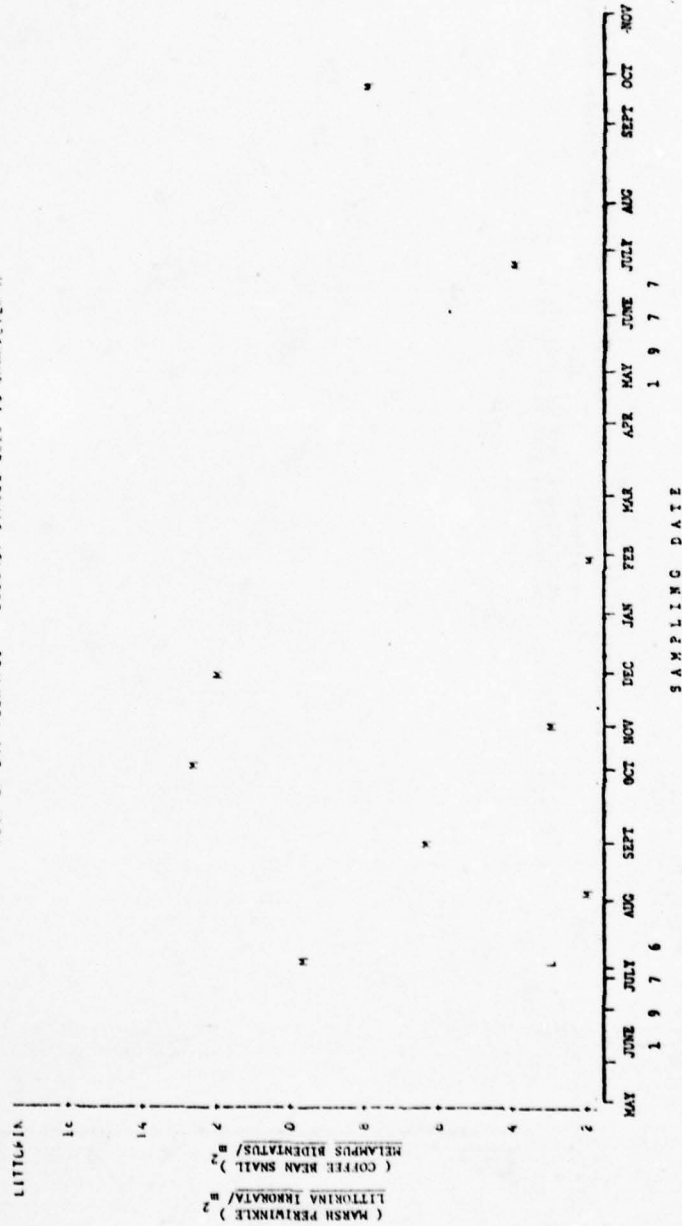
HEIGHT=36

PLT OF DIV. GRASS  
PLT OF DIV. GRASS  
LEGEND: SYMBOL USED IS CHARACTER C  
LEGEND: SYMBOL USED IS CHARACTER B



CONTROL PIPES EVALUATION AT EACH HEIGHT FOR MARSH SNOTHERING  
 11:31 TUESDAY, DECEMBER 20, 1977

HEIGHT: 36  
 SLOTTED OR DAY-LETTERING  
 LEGEND: SYMBOL USED IS CHARACTER M



CONTROL PIPES EVALUATION AT EACH HEIGHT FOR MARSH SMOTHERING  
11:31 TUESDAY, DECEMBER 20, 1977

HEIGHT = 10

PLANT OF DAY-GREEN IN LEGEND SYMBOL USED IS CHARACTER S

FLCAPH-12

PROTECTING CLIMS culms / m<sup>2</sup>  
S. ALTERNIFLORA  
SEEDINGS culms / m<sup>2</sup>

MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
1 9 7 6 1 9 7 7  
SAMPLING DATE



PART 3

B32

WATER QUALITY MONITORING AND WATER RESOURCES MONITORING

WATER QUALITY MONITORING

HEIGHT  
 3- 3 inches 24- 26 inches  
 6- 6 inches 36- 38 inches  
 9- 9 inches  
 12- 12 inches

SUBSTRATE MONTH  
 5A- sand 1- February  
 11- silty sand 3- July  
 12- clay 0- November

CH 2

400

WATER DENSITY g/cm<sup>3</sup>

300

200

100

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV

SAMPLING DATE

WATER SAMPLING DEPTH EVALUATION AND WIND-TEMPERATURE MONITORING  
 10:00 AM 20/21, 21/22, 21/23, 21/24, 21/25, 21/26, 21/27

WIND SPEED (MPH) WIND DIRECTION (DEG)

HEIGHT  
 3- 3 inches 24- 24 inches  
 6- 6 inches 36- 36 inches  
 9- 9 inches  
 12- 12 inches

SUBSTRATE MONTH  
 SA- sand F- February  
 SI- silty sand J- July  
 CI- clay O- November

0  
 100  
 200  
 300  
 400  
 500  
 600  
 700  
 800  
 900  
 1000  
 1100  
 1200  
 1300  
 1400  
 1500  
 1600  
 1700  
 1800  
 1900  
 2000  
 2100  
 2200  
 2300  
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 4100  
 4200  
 4300  
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 7100  
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 7300  
 7400  
 7500  
 7600  
 7700  
 7800  
 7900  
 8000  
 8100  
 8200  
 8300  
 8400  
 8500  
 8600  
 8700  
 8800  
 8900  
 9000  
 9100  
 9200  
 9300  
 9400  
 9500  
 9600  
 9700  
 9800  
 9900  
 10000

GRM DENSITY (g/cm<sup>3</sup>)

B34

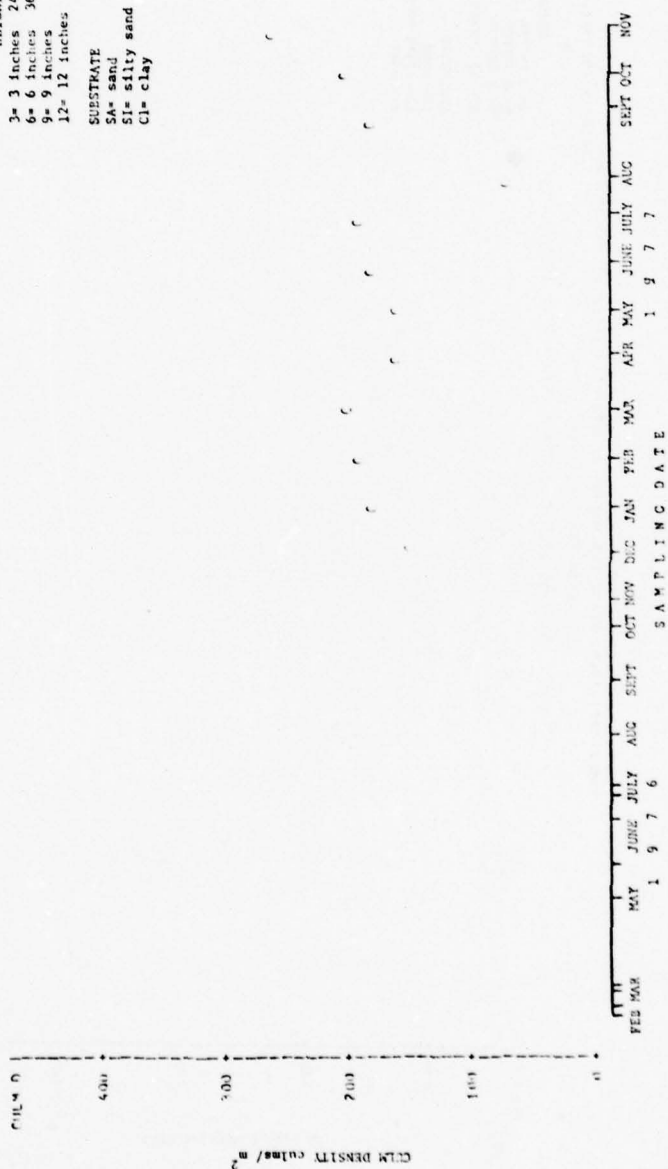
FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 SAMPLING DATE

ST. JES. THOMAS : CREDIT - 1 CREDIT

HEIGHT

3= 3 inches    24= 24 inches  
6= 6 inches    36= 36 inches  
9= 9 inches  
12= 12 inches

SUBSTRATE	MONTH
SA= sand	F= February
SI= silty sand	J= July
Cl= clay	O= November



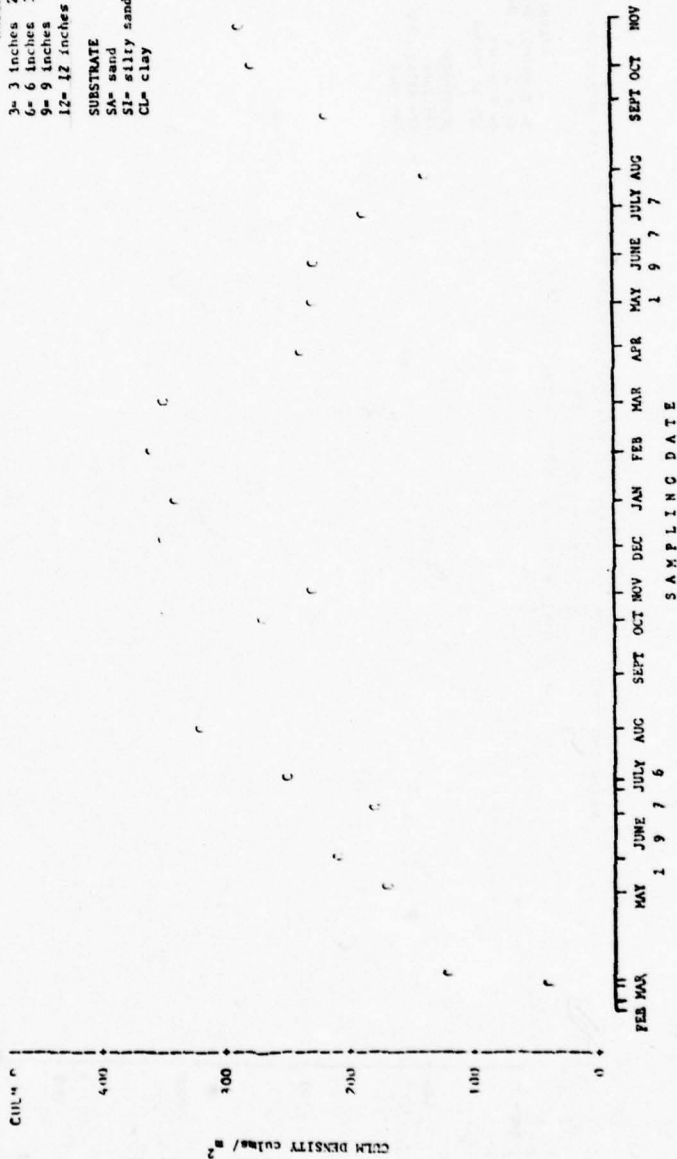
WATER SAMPLING PLANT EVALUATION AND WATER QUALITY REPORT - MONTHLY 10, 1977

STATION: 10123 NICHESWAY, NEWARK, NJ  
 DATE OF SAMPLE: 10/12/77

HEIGHT  
 3- 3 inches 24- 24 inches  
 6- 6 inches 36- 36 inches  
 9- 9 inches  
 12- 12 inches

SUBSTRATE  
 SA- sand  
 SI- silty sand  
 CL- clay

MONTH  
 F- February  
 J- July  
 O- November



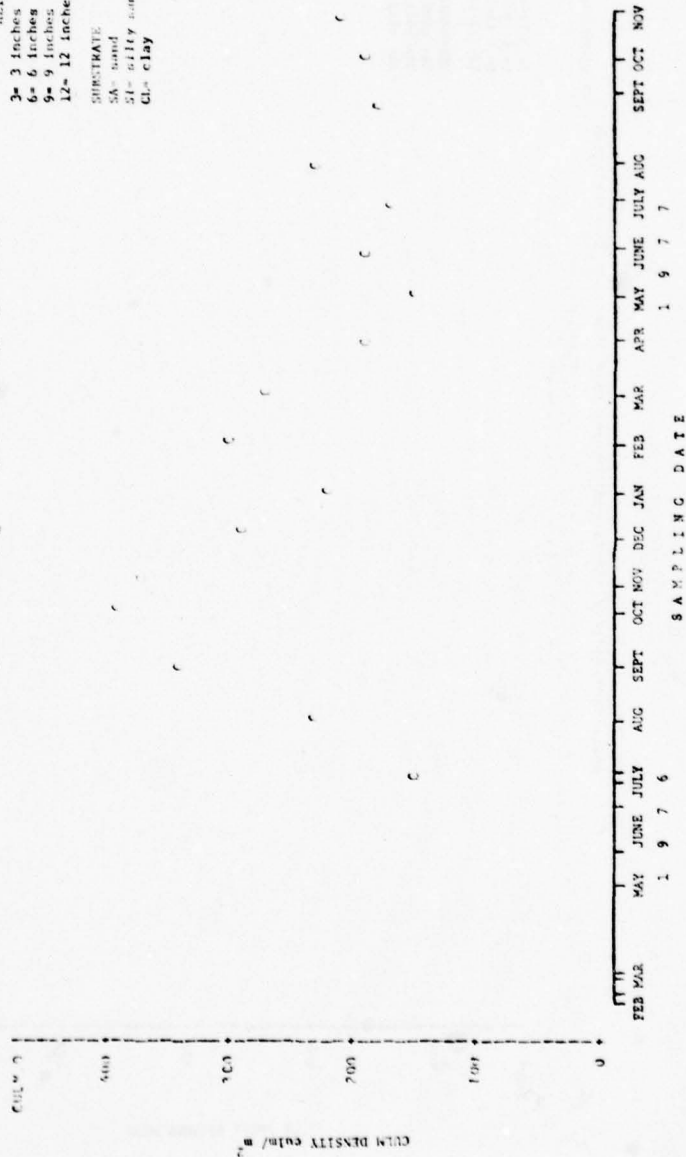


WASH STATE PLANT EVALUATION AND MANAGEMENT REPORT, WASHINGTON 14-23 400-2000, 7-20-77

WATER-LOGGED SOILS (WLS) LOCATION: 50000 US 100

HEIGHT  
 3- 3 inches 24- 24 inches  
 6- 6 inches 36- 36 inches  
 9- 9 inches  
 12- 12 inches

SUBSTRATE NORTH  
 SA- sand F- February  
 SI- silty sand J- July  
 CL- clay O- November



WASH CONTINUING PLANT EVALUATION AND WAGGONMETEER MONITORING 14:23 WEDNESDAY, JULY 21, 1977

WAGGONMETEER MONITORING

PLANT EVALUATION MONITORING

HEIGHT

3- 3 inches 24- 24 inches  
6- 6 inches 36- 36 inches  
9- 9 inches  
12- 12 inches

SUBSTRATE MONTH  
SA- sand F- February  
SI- silty sand J- July  
CL- clay O- November

CULM 0  
400  
300  
200  
100  
0

CULM DENSITY culm/m<sup>3</sup>

B38

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
1 9 7 6 1 9 7 7  
SAMPLING DATE

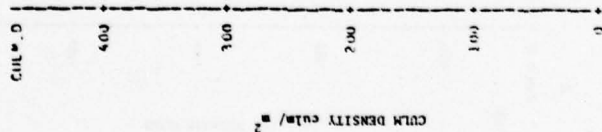
WASH STATE PLANT EVALUATION AND MACROINVERTEBRATE MONITORING  
 WEDNESDAY, AUGUST 21, 1977

PLANT OF EVALUATION: LEGUMINOSAE SYMBOL: LSCN 156

HEIGHT

- 3- 3 inches 24- 24 inches
- 6- 6 inches 36- 36 inches
- 9- 9 inches
- 12- 12 inches

SUBSTRATE MONTH  
 SA= sand F= February  
 SI= silty sand J= July  
 CL= clay O= November



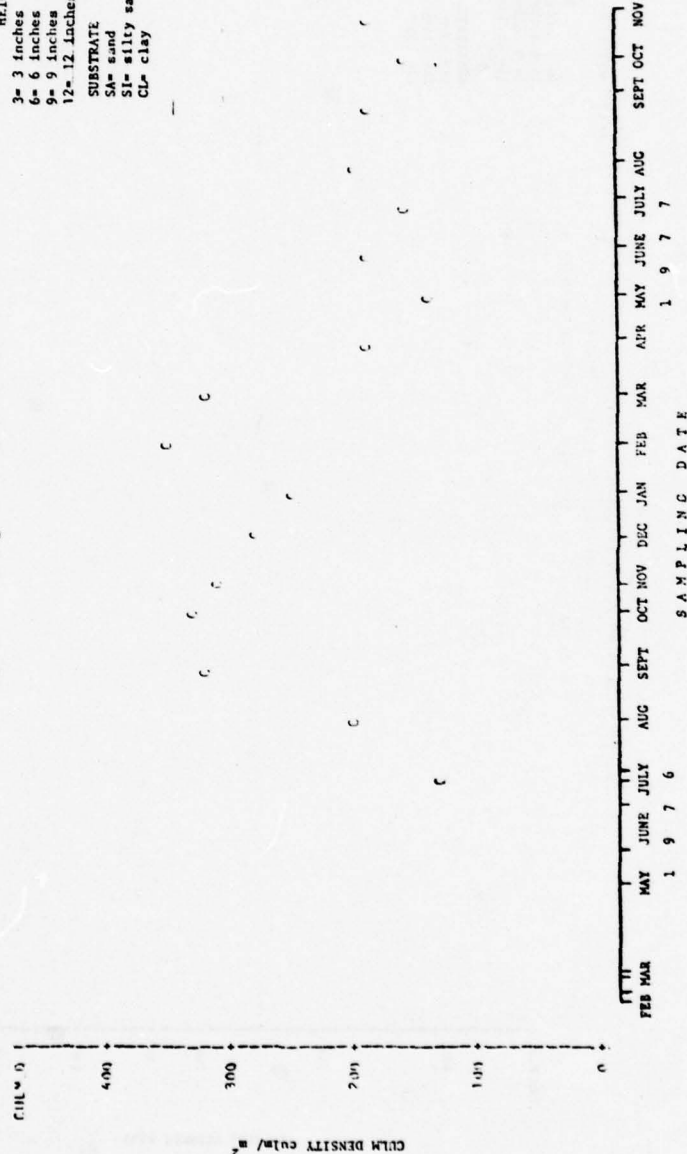
# MARSH SWAMPING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING 16123 WIDOWSLAY, DECEMBER 21, 1977

WEIGHTS: 3 COLLEGE MOSES  
PLOT NO. 151 CULM. - LEGEND: 3000L 151 IN C

HEIGHT  
3= 3 inches 24= 24 inches  
6= 6 inches 36= 36 inches  
9= 9 inches  
12= 12 inches

SUBSTRATE  
SA= sand  
SI= silty sand  
CL= clay

MONTH  
F= February  
J= July  
O= November



MARSH CROPPING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING 14:23 WED. 5042, DEC-21, 1977

HEIGHTS: 3115, 3115, 3115  
 PLANT RE: P. MACULUM. LEGEND: SWAMPY, 100% 100%

HEIGHT  
 3= 3 inches 24= 24 inches  
 6= 6 inches 36= 36 inches  
 9= 9 inches  
 12= 12 inches

SUBSTRATE MONTH  
 SA= sand F= February  
 SI= silty sand J= July  
 CL= clay O= November

CUMULATIVE  
 400  
 300  
 200  
 100  
 0

CUMULATIVE DENSITY  $\text{culm/m}^2$

B41

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6  
 SAMPLING DATE



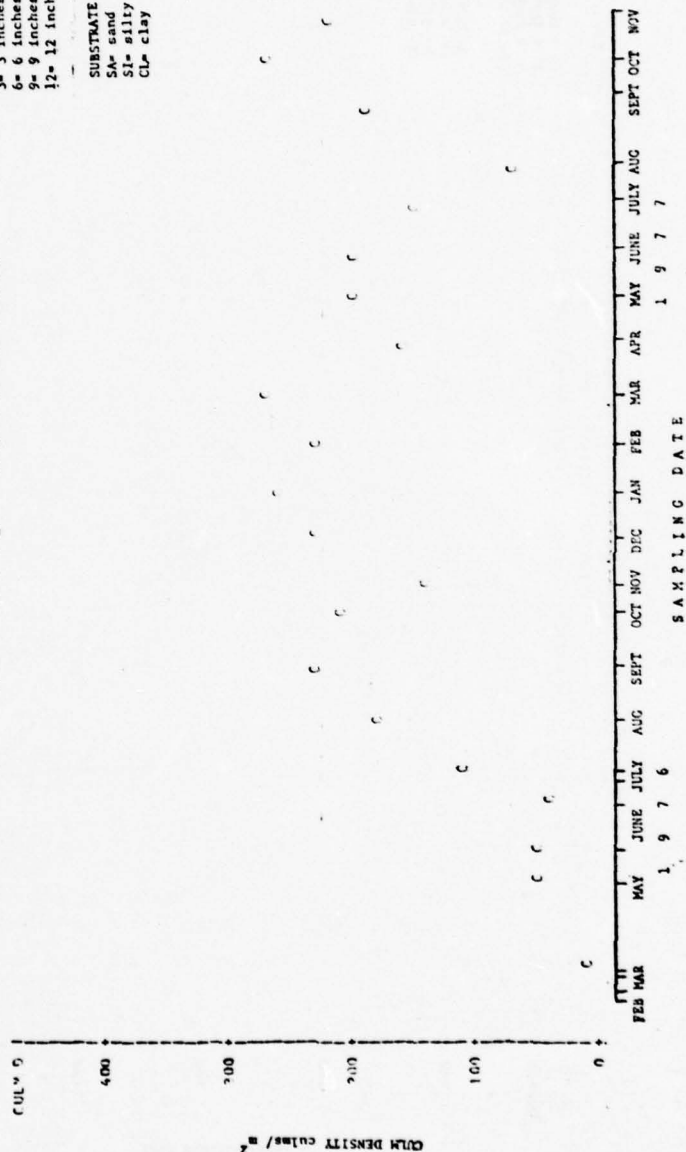
WASH SMOOTHER PLANT EVALUATION AND MACROINVERTEBRATE MONITORING 1A:23 WEDNESDAY, DECEMBER 21, 1977

WEIGHT SETBACK W/STP  
 PLT DE FAYOCHULF LEGEND SYMBOL USED IS C

HEIGHT  
 3- 3 inches 24- 24 inches  
 6- 6 inches 36- 36 inches  
 9- 9 inches  
 12- 12 inches

SUBSTRATE  
 SA- sand  
 SI- silty sand  
 CL- clay

MONTH  
 P- February  
 J- July  
 O- November



# MARCH SUCCEEDING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING

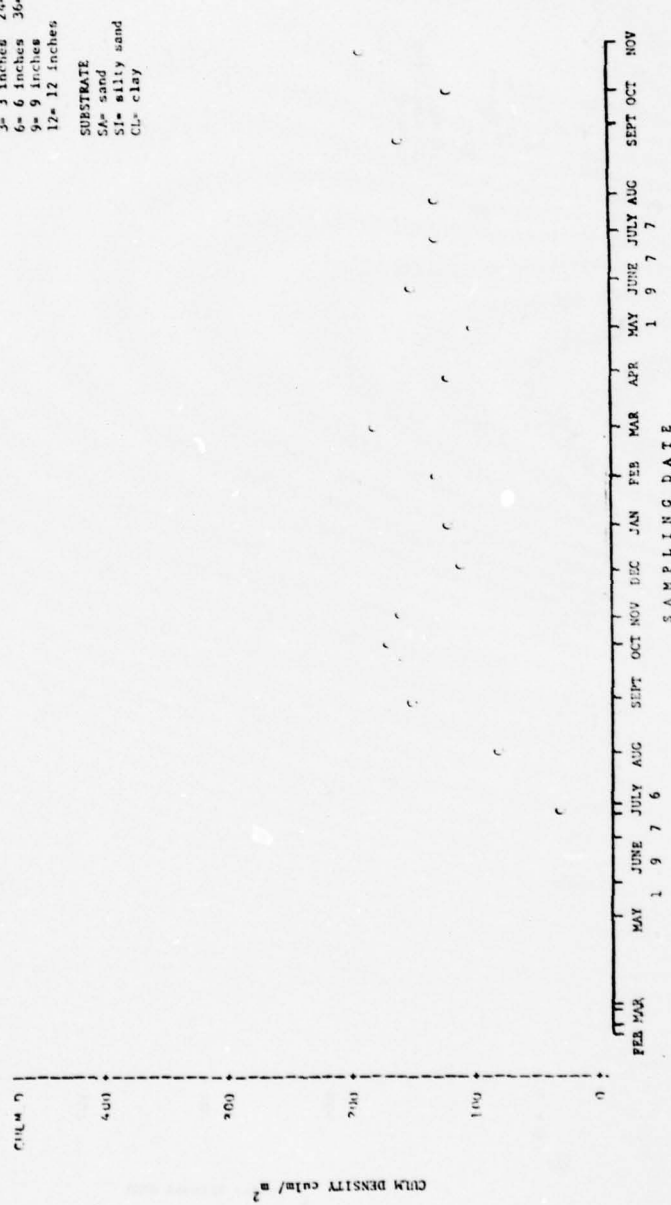
16123 WCON. ST. 21. 1077

HEIGHT 3- 3 inches 24- 24 inches  
6- 6 inches 36- 36 inches  
9- 9 inches  
12- 12 inches

HEIGHT  
3- 3 inches 24- 24 inches  
6- 6 inches 36- 36 inches  
9- 9 inches  
12- 12 inches

SUBSTRATE  
SA= sand  
SI= silty sand  
CL= clay

MONTH  
F= February  
J= July  
O= November



# MARSH SODWATERING PLANT EVALUATION AND WATERPUMP/STORAGE MONITORING 1999 WEDNESDAY, DECEMBER 21, 1999

WATERPUMP/STORAGE MONITORING  
WATERPUMP/STORAGE MONITORING  
WATERPUMP/STORAGE MONITORING

SECTION	WATERPUMP/STORAGE MONITORING
1 = 8 cm	24 = 61 cm
2 = 15 cm	25 = 91 cm
3 = 23 cm	
4 = 30 cm	
SOIL	WCS
Silt Sand	24 February
Silt Sand & Clay	25 July
CLs Clay	26 November

CUL = 0  
400  
300  
200  
100  
0

CULM DENSITY column/ m<sup>2</sup>

B44

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
1 9 7 5  
1 9 7 7  
SAMPLING DATE

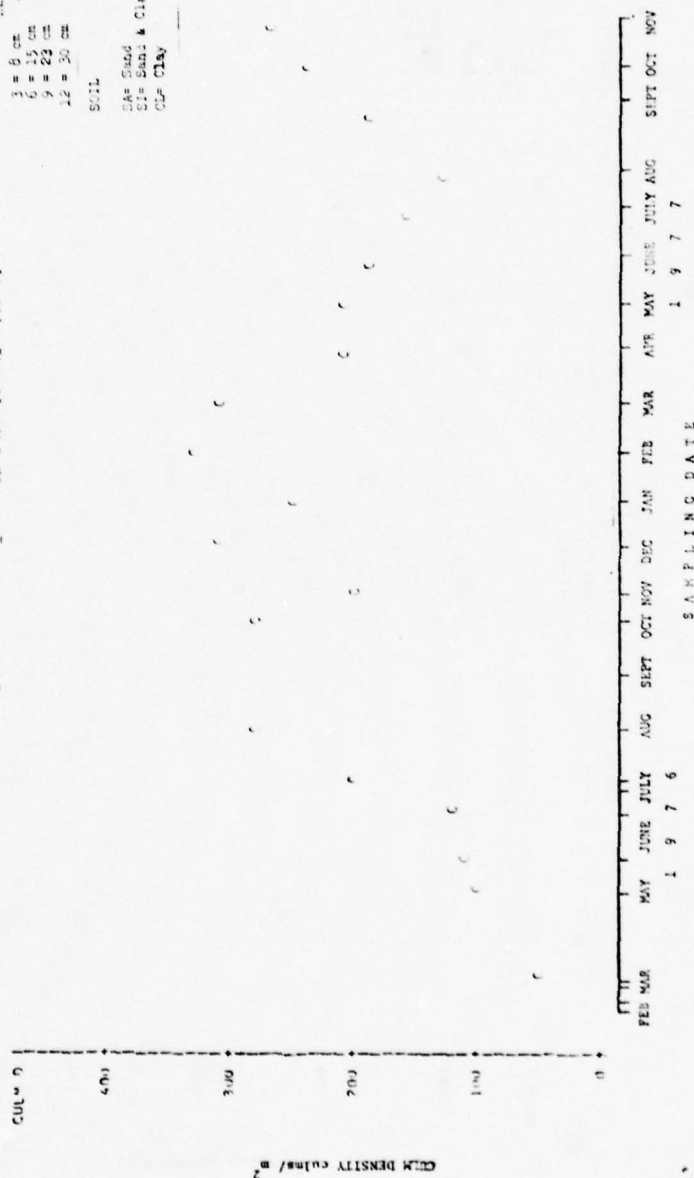
MARSH SMOTHERING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING  
 LAUREL MOUND, ALABAMA, DECEMBER 21, 1977

HEIGHT 60 CM  
 PLOT 100 CM X 100 CM  
 LEGEND: SYMBOL USED TO

HEIGHT  
 3 = 6 CM  
 6 = 15 CM  
 9 = 23 CM  
 12 = 30 CM

MOSS

DA = Sand  
 DI = Sand & Clay  
 CL = Clay  
 PS = Peat  
 J = July  
 O = October



# WATER WEATHERING PLANT EVALUATION AND NICKELINFLUENTATE MONITORING [1973 MEDUSA, [REDACTED] 21, 1977]

HEIGHT OF SOILS (cm)

PLUG OF COLUMBIA LEGEND: SYMBOL USED IS (

HEIGHT  
3 = 8 cm 24 = 61 cm  
6 = 15 cm 36 = 91 cm  
9 = 23 cm  
12 = 30 cm

SOIL MON

SA = Sand  
SI = Sand & Clay  
CL = Clay  
F = February  
J = July  
O = November

COLUMBIA  
400  
300  
200  
100  
0

COLUM DENSITY COLUMBIA / m<sup>2</sup>

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
1 9 7 6 1 9 7 7  
SAMPLING DATE



# WASH SWOTHEING PLANT EVALIATION AND MAGCINHYSTERATE MONITORING

HEICHTA, SILESA MONAD  
 CLAY OF LAYOHLA, LENOVA SYMBOL USED AS C

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

MON  
 1st February  
 1st July  
 1st November

CULM DENSITY

CULM DENSITY culm/m<sup>3</sup>

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7

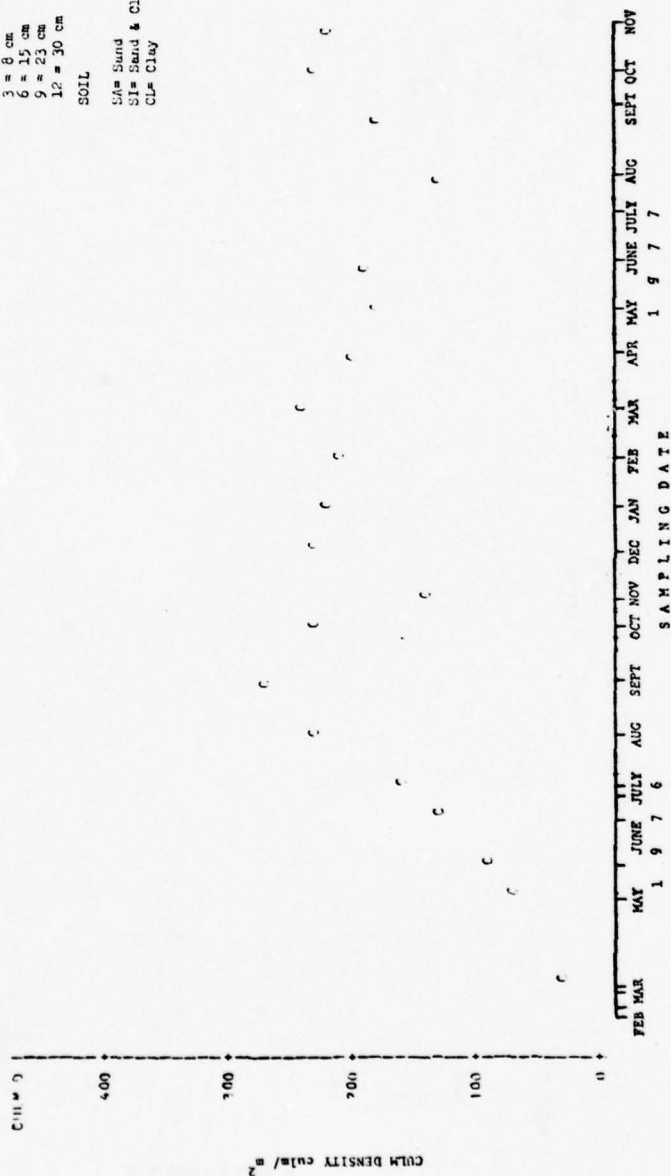
SAMPLING DATE

WASH STATE PLANT EVALUATION AND MACROINVERTEBRATE MONITORING 1-22 WASH. STATE, OCCASIE 21, 1977

HEIGHTS OF SOILS: MON OF  
 PLANT OF GARDENING: LEGEND: SYMBOL USED IS

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm  
 24 = 61 cm  
 36 = 91 cm

SOIL  
 S1 = Sand  
 CL = Clay  
 MON  
 F = February  
 J = July  
 O = November

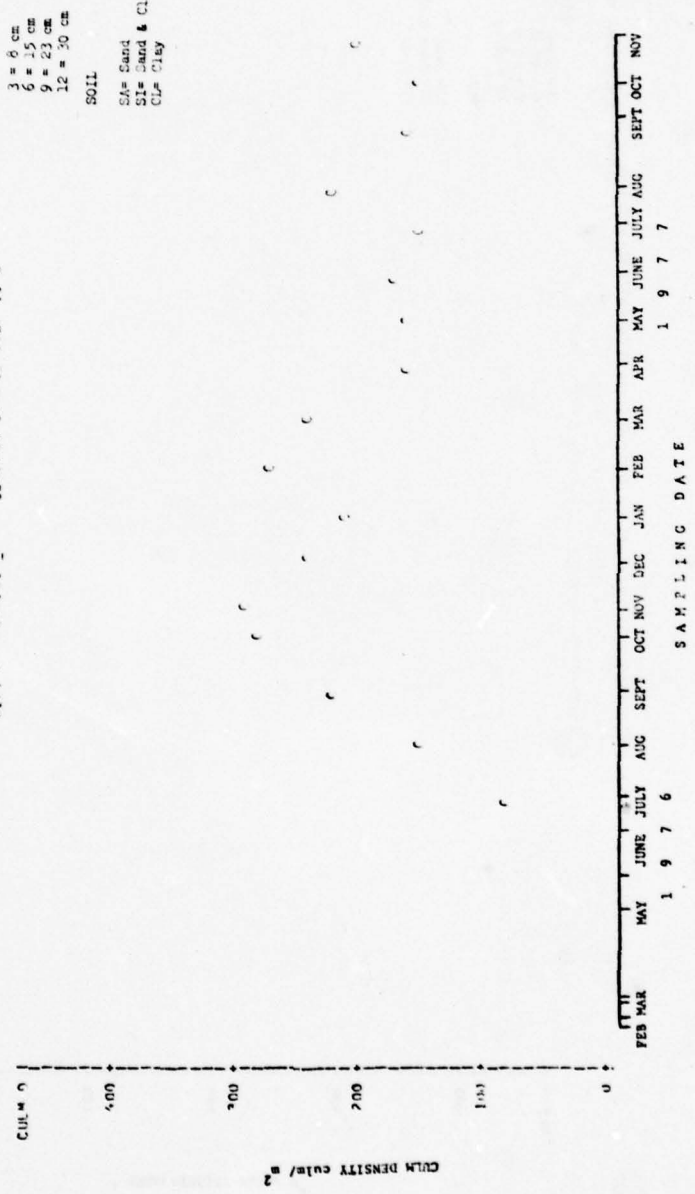


MARSH SODWATERING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING  
 16170 W. 10th St., WYOMING, 82002-2118

HEIGHT 24 = 61 cm  
 36 = 91 cm  
 48 = 121 cm  
 60 = 151 cm  
 72 = 181 cm  
 84 = 211 cm  
 96 = 241 cm  
 108 = 271 cm  
 120 = 301 cm

SOIL MON  
 SA = Sand  
 SI = Sand & Clay  
 CL = Clay

MOON  
 F = February  
 J = July  
 N = November



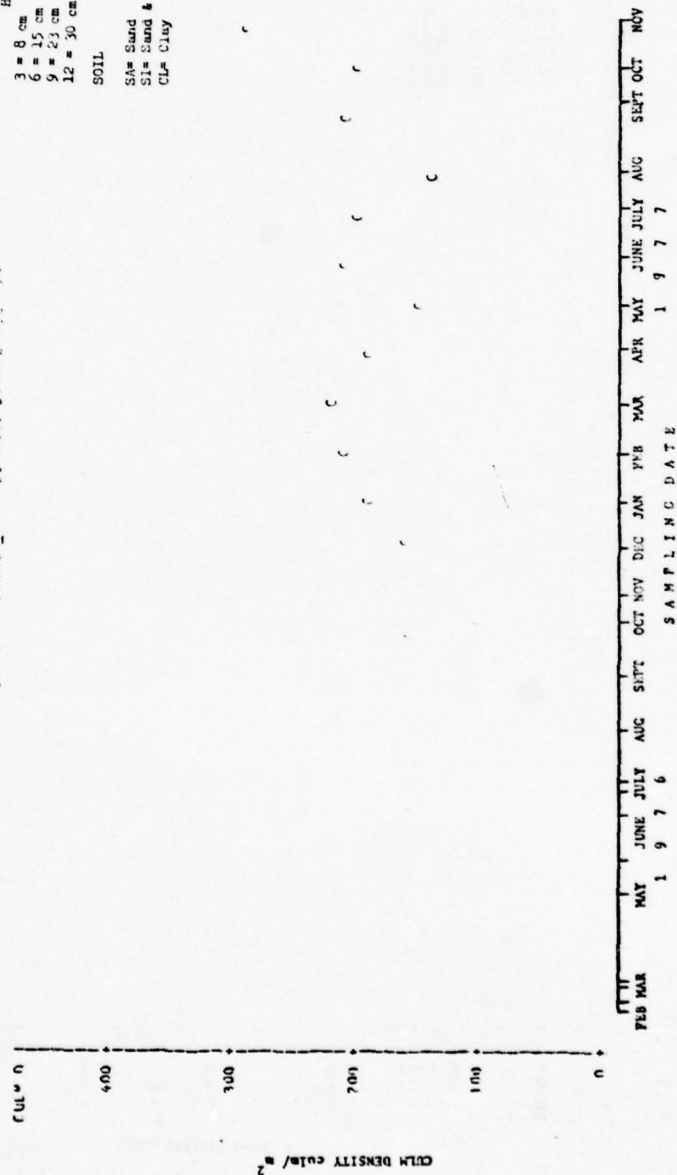
# MARSH SWAMPING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING 16123 HILDA-SWAY, NICEWICK 21, 1977

Soil core analysis  
 Soil core analysis

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 24 cm  
 12 = 30 cm

SOIL  
 SA = Sand  
 SI = Sand & Clay  
 CL = Clay

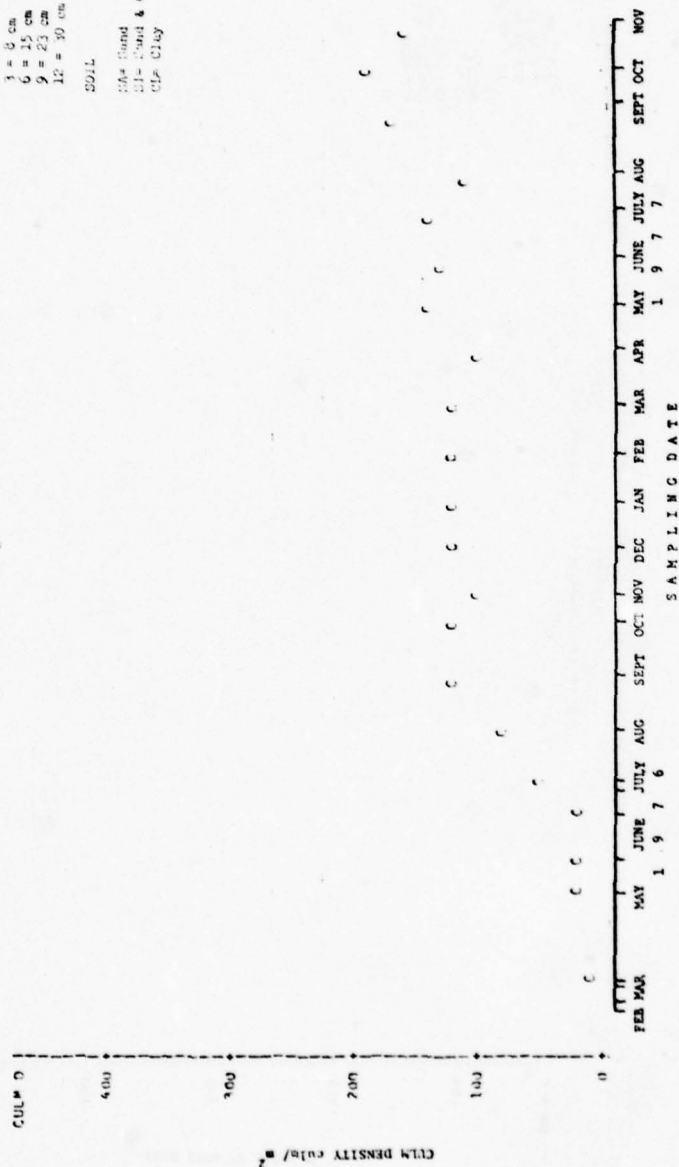
MOON  
 F = February  
 J = July  
 C = November



$\mu = 0.5$ ,  $\sigma = 0.7$

3	= 0 cm	24	= 61 cm
6	= 15 cm	36	= 91 cm
9	= 23 cm		
12	= 30 cm		

SOIL	MGN
Cla's Sand	Fe February
Cla's Sand & Clay	Ja July
Cla's Clay	Oa November





# MARSH SHEPHERDING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING, 10122 WEDNESDAY, RICHMOND 21, 1977

HEIGHTS: 30, 15, 9, 6, 3, 0  
 PLOT OF PLANT CULM DENSITY LEGEND: SWAMP, HSN, IS, C

HEIGHT  
 3 = 0 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL  
 SA = Sand  
 SI = Sand & Clay  
 CL = Clay

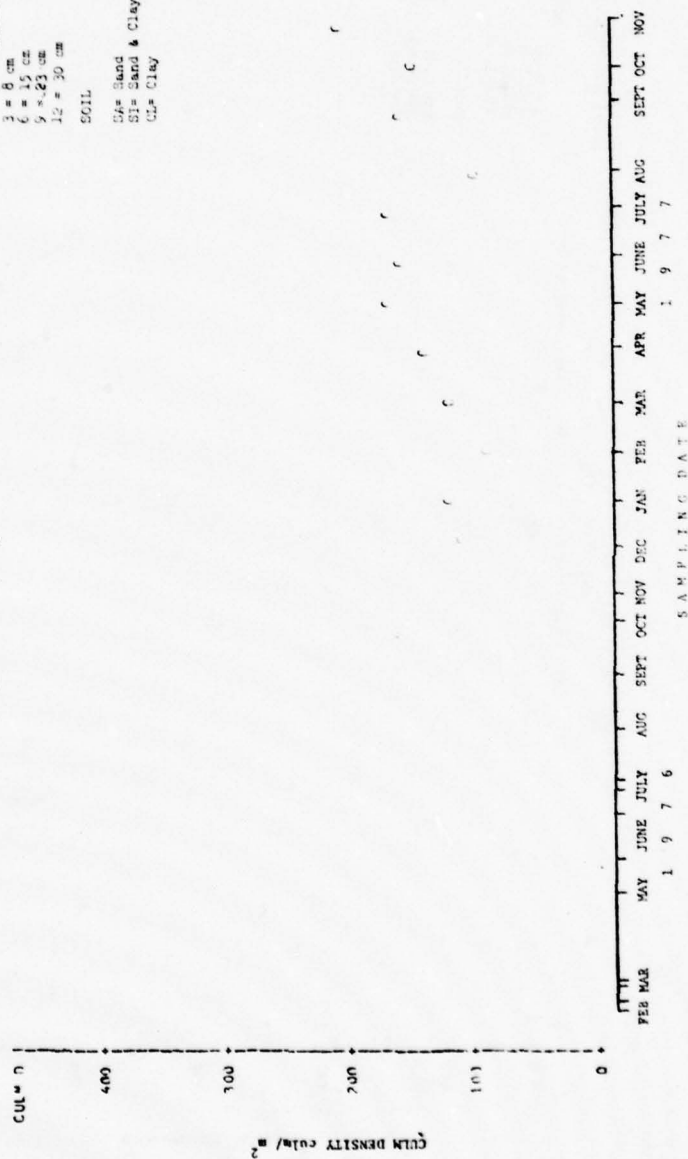
CULM DENSITY culm/m<sup>2</sup>

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 SAMPLING DATE

$$u = \frac{1}{2} \left( \frac{1}{\sqrt{2}} \begin{pmatrix} 1 & i \\ 1 & -i \end{pmatrix} \right)^2 = \frac{1}{2} \begin{pmatrix} 1 & -1 \\ 1 & 1 \end{pmatrix}$$

HEIGHT	
3 = 8 cm	24 = 61 cm
6 = 15 cm	36 = 91 cm
9 = 23 cm	
12 = 30 cm	

SOIL	MON
SA= Sand	F= February
SI= Sand & Clay	J= July
CL= Clay	O= November



MARSH SMOOTHING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING 10223 WISCONSIN, DECEMBER 21, 1977

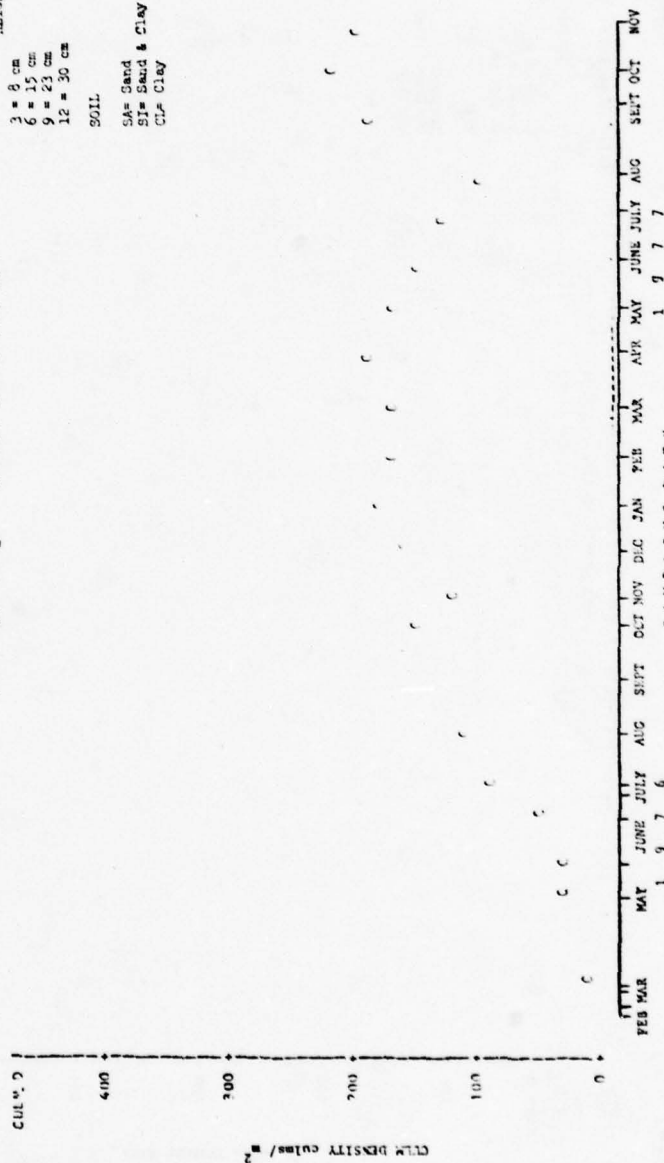
HEIGHTS: SEE PAGE 10223

PLANT CE DATA: 10223 USED IS C

HEIGHT  
3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

SOIL

SA = Sand  
SI = Sand & Clay  
CL = Clay  
F = February  
J = July  
O = November

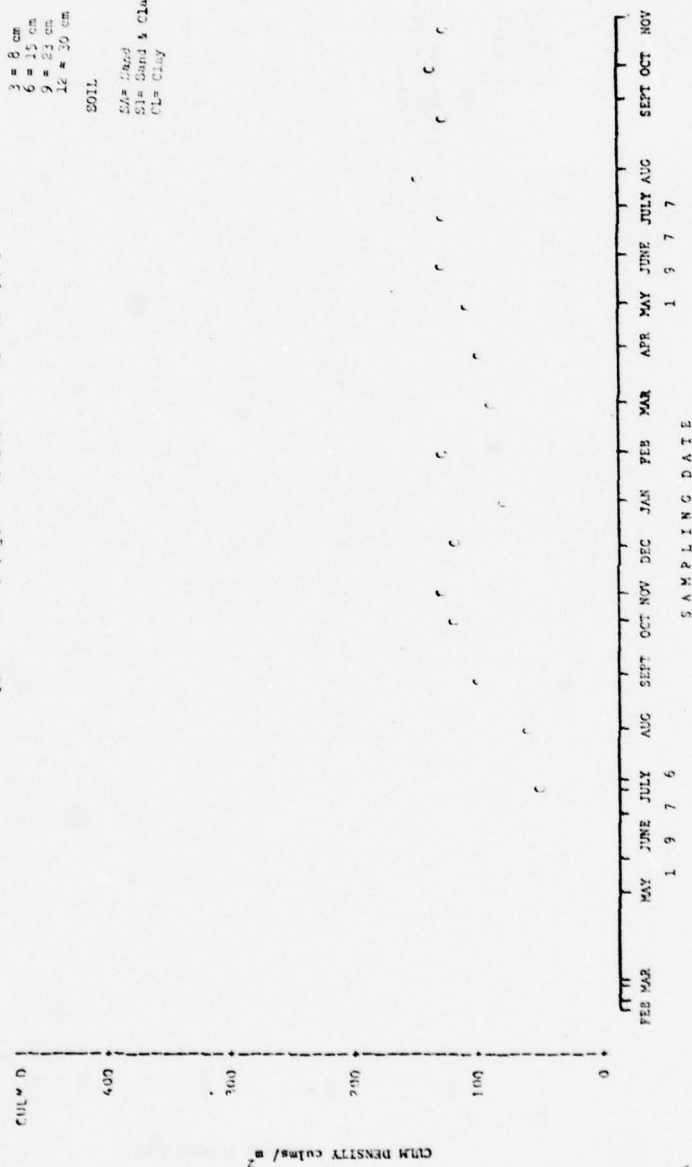


$$F = \frac{1}{2} \left( \frac{1}{\mu_0} \mathbf{E}^2 - \mathbf{E} \cdot \mathbf{B} \right)$$

PICTURE PLACEMENT: SEND: SYMBOLS IS A

HEIGHT	
3 = 8 cm	24 = 61 cm
6 = 15 cm	36 = 91 cm
9 = 23 cm	
12 = 30 cm	

SOIL. MON  
*Ss*= Sand  
*Sls*= Sand & Clay  
*Cl*= Clay  
*F*= February  
*J*= July  
*O*= November

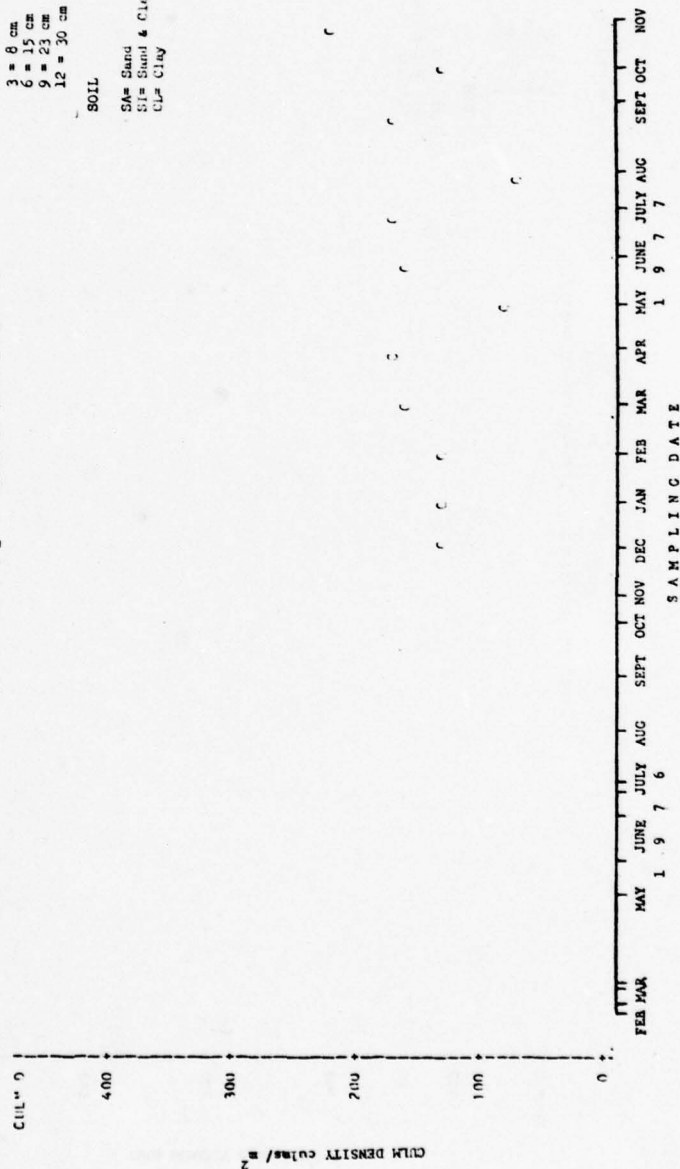


# MARSH SMOTHERING PLANT EVALUATION AND MACEINVESTIGATE MONITORING 1973 MONESDAY, DECEMBER 21, 1977

HEIGHT = 0 SCULPS MONES  
 PLOT OF CUMULATIVE LEGEND SYMBOL USED TO C

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm  
 24 = 61 cm  
 36 = 91 cm

SOIL MON  
 SM = Sand  
 SL = Sand & Clay  
 CL = Clay  
 F = February  
 J = July  
 O = November





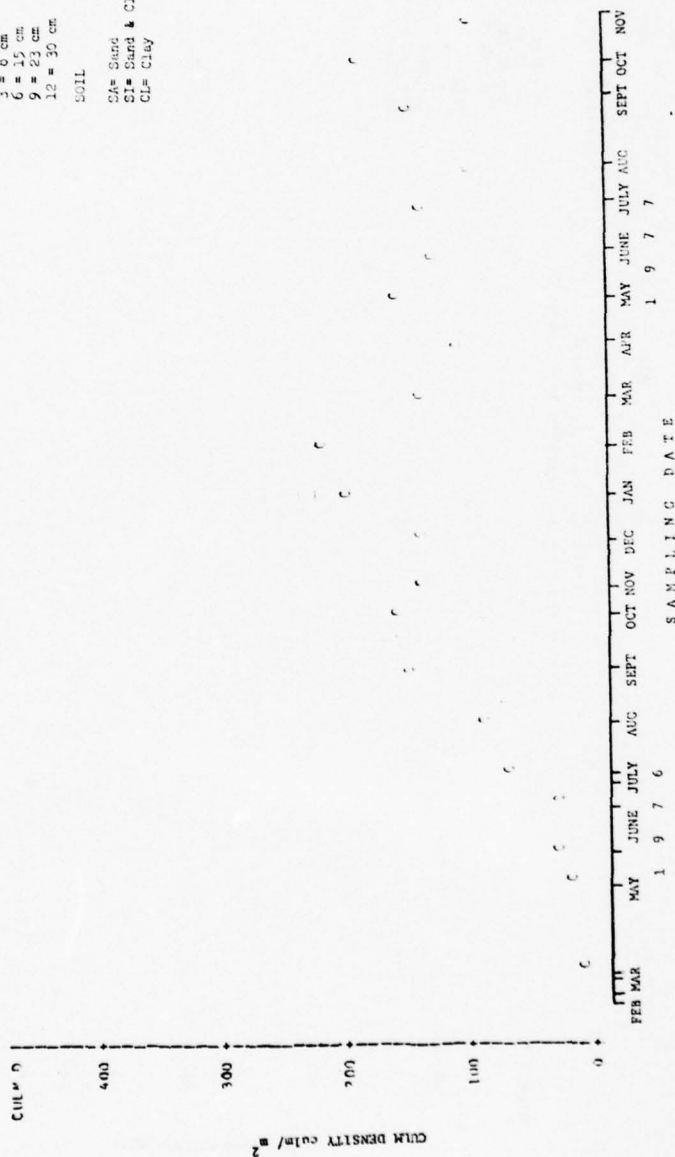
WADSWORTH PLANT EVALUATION AND MACROINVERTEBRATE MONITORING, 21, 1977

WEIGHTED SPREAD MONITOR

PLOT OF PLANT HEIGHT (cm) vs. DATE

HEIGHT  
3 = 6 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

SOIL  
S1 = Sand  
S2 = Sand & Clay  
C1 = Clay  
MUN  
F = February  
J = July  
O = November

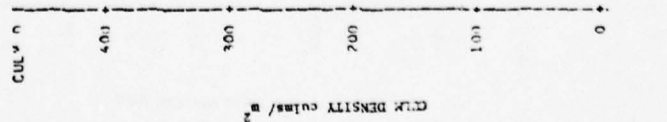


WASH CROPPING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING 16523 WEDNESDAY, OCTOBER 21, 1977 27

HEIGHT= SCILED MONAD  
PLOT OF CAY-CUL-11 LECTIO: SYMBOL USED IS C

HEIGHT  
3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm  
24 = 61 cm  
36 = 91 cm

SOIL  
SA = Sand  
SI = Sand & Clay  
CL = Clay  
MOI  
F = February  
J = July  
O = November



MARSH SWAMPING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING  
 WEDNESDAY, DECEMBER 21, 1977

HEIGHT 30 cm  
 SOIL=ST MON  
 PLOT OF PLANTGROWTH LEGEND: SYMBOL HEIGHT

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL  
 S1 = Sand  
 S2 = Sand & Clay  
 CL = Clay

CULM DENSITY culm/m<sup>2</sup>

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 SAMPLING DATE

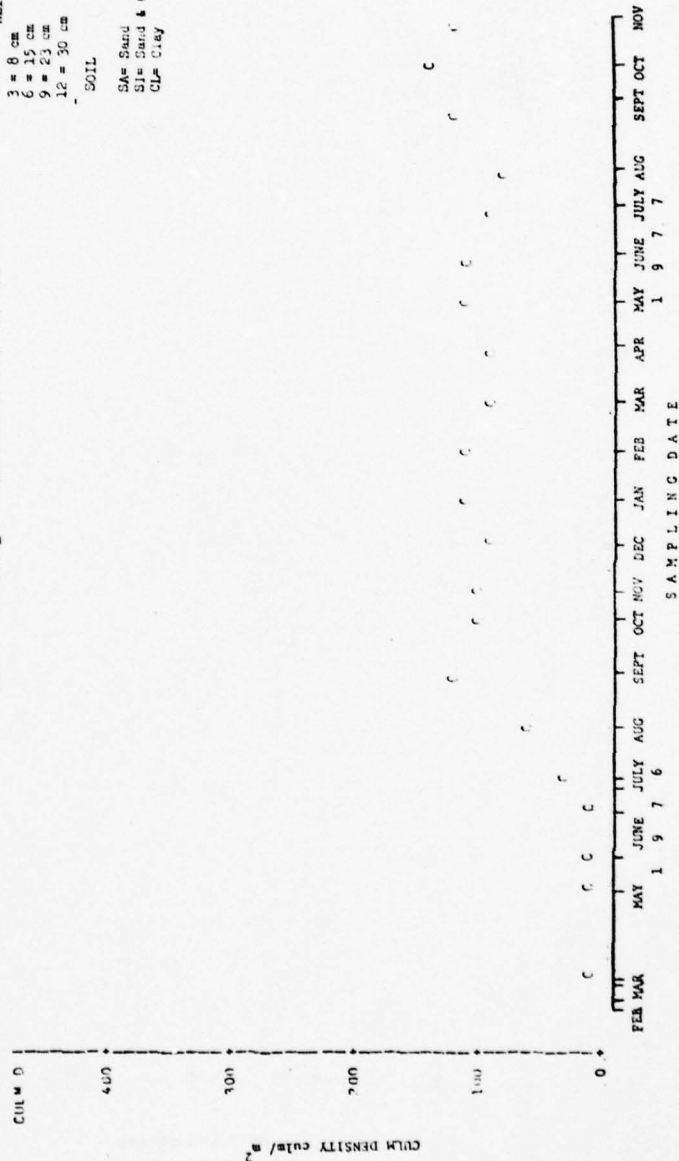
MARSH SMOTHERING PLANT EVALUATION AND MANAGEMENT MONITORING 10:00 WEDNESDAY, DECEMBER 21, 1977

HEIGHT 12 SOIL MON  
PLOT OF CUMULUM MON

HEIGHT  
3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm  
24 = 61 cm  
36 = 91 cm

SOIL  
SM = Sand  
SJC = Sand & Clay  
CL = Clay

MON  
F = February  
J = July  
O = October



MARSH SWOTCHING PLANT EVALUATION AND MAGNETIC/TEMPERATURE MONITORING 16193 450N 50.5W, DECEMBER 21, 1977 30

WEIGHT=12 CIL=CL MCH=1  
 PLANT OF DAY=CLAY LEGEND: SYMBOL USED IS C

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL

MIN  
 SM= Sand  
 SL= Sand & Clay  
 CL= Clay  
 P= February  
 J= July  
 O= November

CULM DENSITY culm/m<sup>2</sup>

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 S A M P L I N G D A T E



# MARSH SNOTHERING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING LAKE 23 W. OHIO SPRAY, DECEMBER 21, 1977

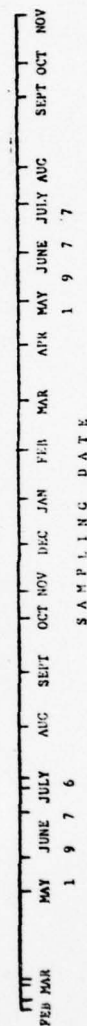
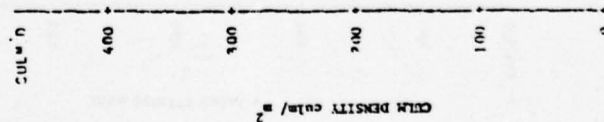
HEIGHT=12 SOIL=CL MTH=J

PLANT OR ELEVATION LEGEND: SYMBOL USED IS C

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL  
 SA = Sand  
 SI = Sand & Clay  
 CL = Clay

MOON  
 F = February  
 J = July  
 O = November

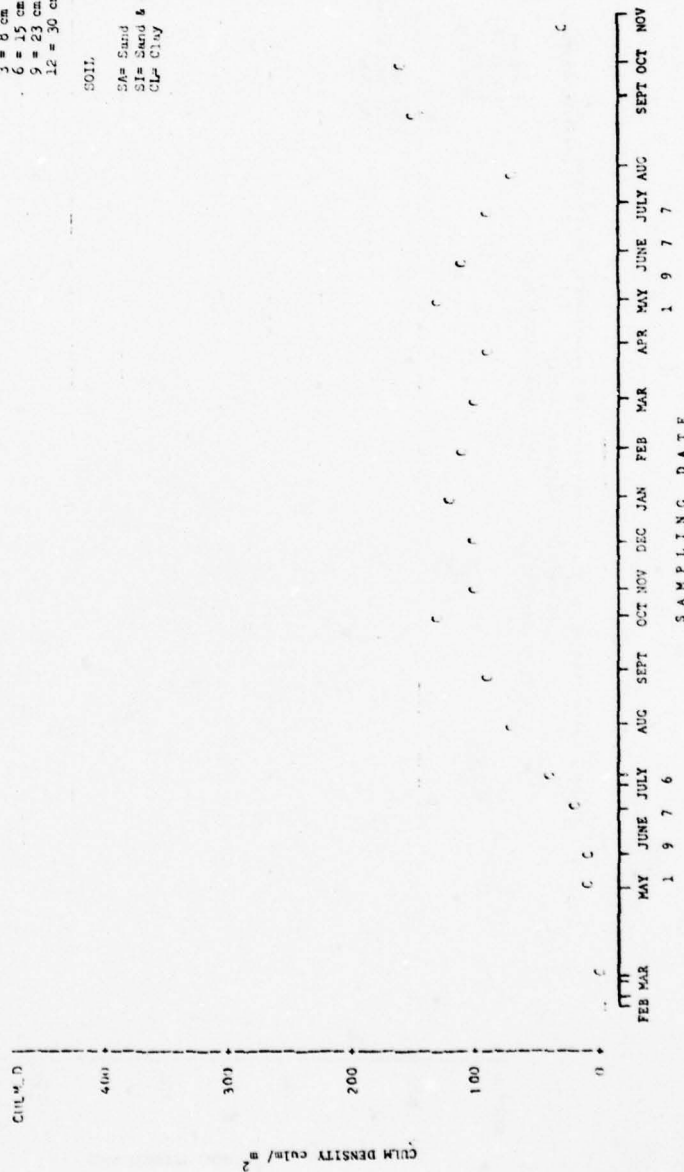


# MARSH SMOTHERING PLANT EVALUATION AND MAGNIFICATION MONITORING 16:33 WEDNESDAY, 0-0-00 21, 1977

HEIGHT=12 SOIL=CA MON=2  
 PLOT OF DAY-COLUMN LEFT: SYMBOL USED IS C

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL MON  
 SA= Sand  
 SI= Sand & Clay  
 CL= Clay  
 F= February  
 J= July  
 O= November



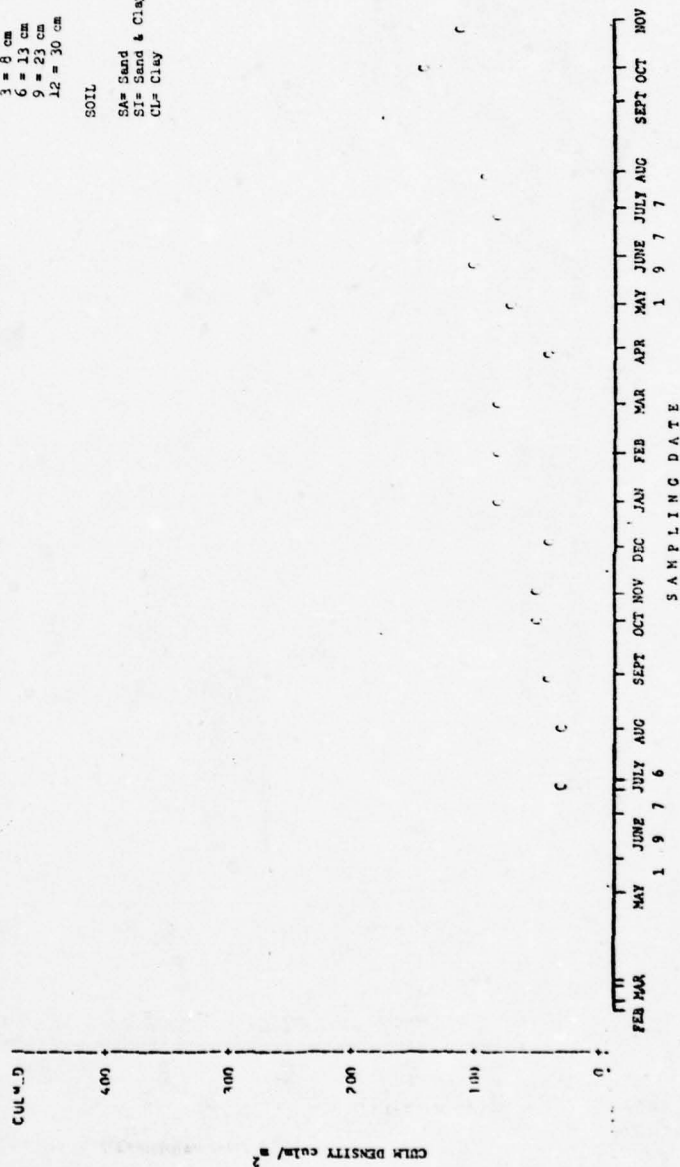
MARSH SUCCESSION PLANT EVALUATION AND MACROINVERTEBRATE MONITORING  
 16:22 WEDNESDAY, SEPTEMBER 21, 1977

HEIGHT=12 SOIL=SA MON=J  
 PLOT OF DAY=CULM.D. LEGEND: SYMBOL USED IS C

HEIGHT  
 3 = 8 cm  
 6 = 13 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL  
 SA= Sand  
 SI= Sand & Clay  
 CL= Clay

MON  
 F= February  
 J= July  
 O= November



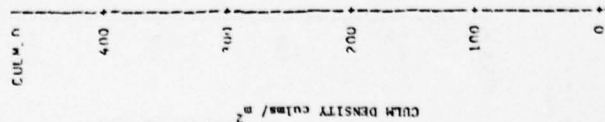
B64

WASH STATE PLANT EVALUATION AND MACROINVERTEBRATE MONITORING 34  
 1973 WEDNESDAY, DECEMBER 21, 1977

HEIGHTED COLLESA MOUNTAIN  
 PLOT OF CANYON MOUNTAIN

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm  
 24 = 61 cm  
 36 = 91 cm

SOIL  
 Silt Sand  
 Silt Sand & Clay  
 CL = Clay  
 MGR  
 F = February  
 J = July  
 O = November

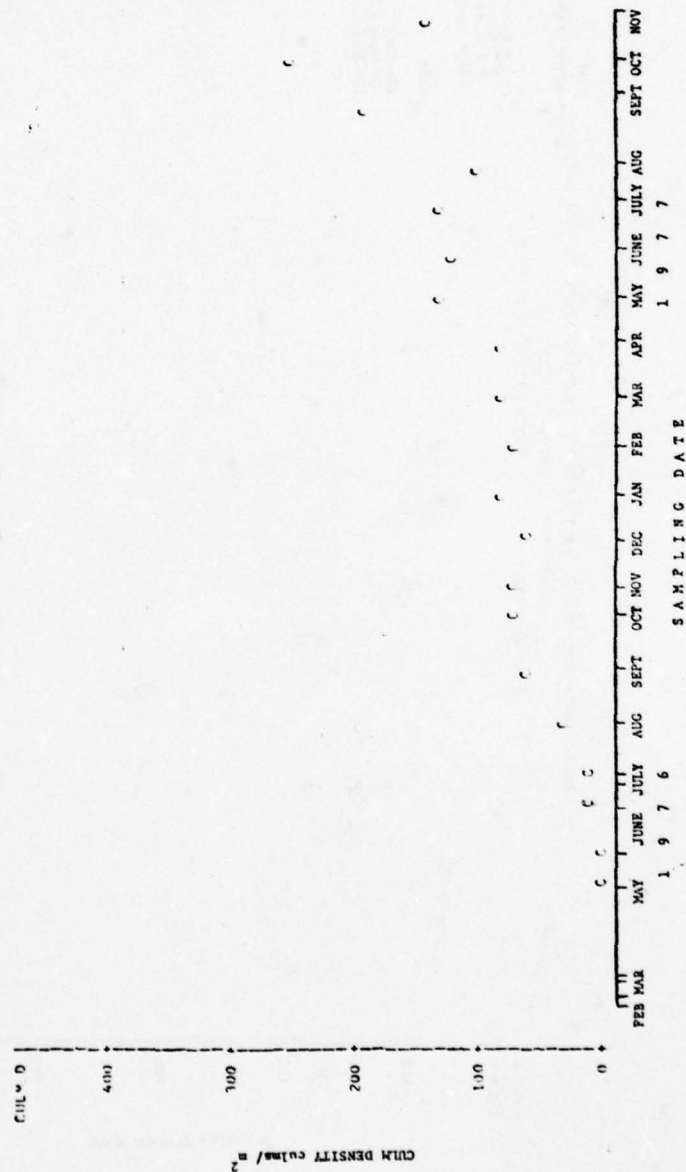


FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 SAMPLING DATE

WASH SWAMPING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING 16:23 WEDNESDAY, DECEMBER 21, 1977 35

HEIGHT=12 SCIL=51 MCN=2

PLOT OF DENSITY vs DATE LEGEND: SYMBOL USED IS C





MARSH SWAMPING PLANT EVALUATION AND WATER TEMPERATURE MONITORING 1973 MONDAY, DECEMBER 21, 1973

HEIGHTS: 24 = 61 cm

HEIGHTS: 30 = 91 cm

HEIGHTS: 36 = 91 cm

HEIGHTS: 42 = 107 cm

HEIGHTS: 48 = 123 cm

HEIGHTS: 54 = 139 cm

HEIGHTS: 60 = 155 cm

HEIGHTS: 66 = 171 cm

HEIGHTS: 72 = 187 cm

HEIGHTS: 78 = 203 cm

HEIGHTS: 84 = 219 cm

HEIGHTS: 90 = 235 cm

HEIGHTS: 96 = 251 cm

HEIGHTS: 102 = 267 cm

HEIGHTS: 108 = 283 cm

HEIGHTS: 114 = 299 cm

HEIGHTS: 120 = 315 cm

HEIGHTS: 126 = 331 cm

HEIGHTS: 132 = 347 cm

HEIGHTS: 138 = 363 cm

HEIGHTS: 144 = 379 cm

HEIGHTS: 150 = 395 cm

HEIGHTS: 156 = 411 cm

HEIGHTS: 162 = 427 cm

HEIGHTS: 168 = 443 cm

HEIGHTS: 174 = 459 cm

HEIGHTS: 180 = 475 cm

HEIGHTS: 186 = 491 cm

HEIGHTS: 192 = 507 cm

HEIGHTS: 198 = 523 cm

HEIGHTS: 204 = 539 cm

HEIGHTS: 210 = 555 cm

HEIGHTS: 216 = 571 cm

HEIGHTS: 222 = 587 cm

HEIGHTS: 228 = 603 cm

HEIGHTS: 234 = 619 cm

HEIGHTS: 240 = 635 cm

HEIGHTS: 246 = 651 cm

HEIGHTS: 252 = 667 cm

HEIGHTS: 258 = 683 cm

HEIGHTS: 264 = 699 cm

HEIGHTS: 270 = 715 cm

HEIGHTS: 276 = 731 cm

HEIGHTS: 282 = 747 cm

HEIGHTS: 288 = 763 cm

HEIGHTS: 294 = 779 cm

HEIGHTS: 300 = 795 cm

HEIGHTS: 306 = 811 cm

HEIGHTS: 312 = 827 cm

HEIGHTS: 318 = 843 cm

HEIGHTS: 324 = 859 cm

HEIGHTS: 330 = 875 cm

HEIGHTS: 336 = 891 cm

HEIGHTS: 342 = 907 cm

HEIGHTS: 348 = 923 cm

HEIGHTS: 354 = 939 cm

HEIGHTS: 360 = 955 cm

HEIGHTS: 366 = 971 cm

HEIGHTS: 372 = 987 cm

HEIGHTS: 378 = 1003 cm

HEIGHTS: 384 = 1019 cm

HEIGHTS: 390 = 1035 cm

HEIGHTS: 396 = 1051 cm

HEIGHTS: 402 = 1067 cm

HEIGHTS: 408 = 1083 cm

HEIGHTS: 414 = 1099 cm

HEIGHTS: 420 = 1115 cm

HEIGHTS: 426 = 1131 cm

HEIGHTS: 432 = 1147 cm

HEIGHTS: 438 = 1163 cm

HEIGHTS: 444 = 1179 cm

HEIGHTS: 450 = 1195 cm

HEIGHTS: 456 = 1211 cm

HEIGHTS: 462 = 1227 cm

HEIGHTS: 468 = 1243 cm

HEIGHTS: 474 = 1259 cm

HEIGHTS: 480 = 1275 cm

HEIGHTS: 486 = 1291 cm

HEIGHTS: 492 = 1307 cm

HEIGHTS: 498 = 1323 cm

HEIGHTS: 504 = 1339 cm

HEIGHTS: 510 = 1355 cm

HEIGHTS: 516 = 1371 cm

HEIGHTS: 522 = 1387 cm

HEIGHTS: 528 = 1403 cm

HEIGHTS: 534 = 1419 cm

HEIGHTS: 540 = 1435 cm

HEIGHTS: 546 = 1451 cm

HEIGHTS: 552 = 1467 cm

HEIGHTS: 558 = 1483 cm

HEIGHTS: 564 = 1499 cm

HEIGHTS: 570 = 1515 cm

HEIGHTS: 576 = 1531 cm

HEIGHTS: 582 = 1547 cm

HEIGHTS: 588 = 1563 cm

HEIGHTS: 594 = 1579 cm

HEIGHTS: 600 = 1595 cm

HEIGHTS: 606 = 1611 cm

HEIGHTS: 612 = 1627 cm

HEIGHTS: 618 = 1643 cm

HEIGHTS: 624 = 1659 cm

HEIGHTS: 630 = 1675 cm

HEIGHTS: 636 = 1691 cm

HEIGHTS: 642 = 1707 cm

HEIGHTS: 648 = 1723 cm

HEIGHTS: 654 = 1739 cm

HEIGHTS: 660 = 1755 cm

HEIGHTS: 666 = 1771 cm

HEIGHTS: 672 = 1787 cm

HEIGHTS: 678 = 1803 cm

HEIGHTS: 684 = 1819 cm

HEIGHTS: 690 = 1835 cm

HEIGHTS: 696 = 1851 cm

HEIGHTS: 702 = 1867 cm

HEIGHTS: 708 = 1883 cm

HEIGHTS: 714 = 1899 cm

HEIGHTS: 720 = 1915 cm

HEIGHTS: 726 = 1931 cm

HEIGHTS: 732 = 1947 cm

HEIGHTS: 738 = 1963 cm

HEIGHTS: 744 = 1979 cm

HEIGHTS: 750 = 1995 cm

HEIGHTS: 756 = 2011 cm

HEIGHTS: 762 = 2027 cm

HEIGHTS: 768 = 2043 cm

HEIGHTS: 774 = 2059 cm

HEIGHTS: 780 = 2075 cm

HEIGHTS: 786 = 2091 cm

HEIGHTS: 792 = 2107 cm

HEIGHTS: 798 = 2123 cm

HEIGHTS: 804 = 2139 cm

HEIGHTS: 810 = 2155 cm

HEIGHTS: 816 = 2171 cm

HEIGHTS: 822 = 2187 cm

HEIGHTS: 828 = 2203 cm

HEIGHTS: 834 = 2219 cm

HEIGHTS: 840 = 2235 cm

HEIGHTS: 846 = 2251 cm

HEIGHTS: 852 = 2267 cm

HEIGHTS: 858 = 2283 cm

HEIGHTS: 864 = 2299 cm

HEIGHTS: 870 = 2315 cm

HEIGHTS: 876 = 2331 cm

HEIGHTS: 882 = 2347 cm

HEIGHTS: 888 = 2363 cm

HEIGHTS: 894 = 2379 cm

HEIGHTS: 900 = 2395 cm

HEIGHTS: 906 = 2411 cm

HEIGHTS: 912 = 2427 cm

HEIGHTS: 918 = 2443 cm

HEIGHTS: 924 = 2459 cm

HEIGHTS: 930 = 2475 cm

HEIGHTS: 936 = 2491 cm

HEIGHTS: 942 = 2507 cm

HEIGHTS: 948 = 2523 cm

HEIGHTS: 954 = 2539 cm

HEIGHTS: 960 = 2555 cm

HEIGHTS: 966 = 2571 cm

HEIGHTS: 972 = 2587 cm

HEIGHTS: 978 = 2603 cm

HEIGHTS: 984 = 2619 cm

HEIGHTS: 990 = 2635 cm

HEIGHTS: 996 = 2651 cm

HEIGHTS: 1002 = 2667 cm

HEIGHTS: 1008 = 2683 cm

HEIGHTS: 1014 = 2699 cm

HEIGHTS: 1020 = 2715 cm

HEIGHTS: 1026 = 2731 cm

HEIGHTS: 1032 = 2747 cm

HEIGHTS: 1038 = 2763 cm

HEIGHTS: 1044 = 2779 cm

HEIGHTS: 1050 = 2795 cm

HEIGHTS: 1056 = 2811 cm

HEIGHTS: 1062 = 2827 cm

HEIGHTS: 1068 = 2843 cm

HEIGHTS: 1074 = 2859 cm

HEIGHTS: 1080 = 2875 cm

HEIGHTS: 1086 = 2891 cm

HEIGHTS: 1092 = 2907 cm

HEIGHTS: 1098 = 2923 cm

HEIGHTS: 1104 = 2939 cm

HEIGHTS: 1110 = 2955 cm

HEIGHTS: 1116 = 2971 cm

HEIGHTS: 1122 = 2987 cm

HEIGHTS: 1128 = 3003 cm

HEIGHTS: 1134 = 3019 cm

HEIGHTS: 1140 = 3035 cm

HEIGHTS: 1146 = 3051 cm

HEIGHTS: 1152 = 3067 cm

HEIGHTS: 1158 = 3083 cm

HEIGHTS: 1164 = 3099 cm

HEIGHTS: 1170 = 3115 cm

HEIGHTS: 1176 = 3131 cm

HEIGHTS: 1182 = 3147 cm

HEIGHTS: 1188 = 3163 cm

HEIGHTS: 1194 = 3179 cm

HEIGHTS: 1200 = 3195 cm

HEIGHTS: 1206 = 3211 cm

HEIGHTS: 1212 = 3227 cm

HEIGHTS: 1218 = 3243 cm

HEIGHTS: 1224 = 3259 cm

HEIGHTS: 1230 = 3275 cm

HEIGHTS: 1236 = 3291 cm

HEIGHTS: 1242 = 3307 cm

HEIGHTS: 1248 = 3323 cm

HEIGHTS: 1254 = 3339 cm

HEIGHTS: 1260 = 3355 cm

HEIGHTS: 1266 = 3371 cm

HEIGHTS: 1272 = 3387 cm

HEIGHTS: 1278 = 3403 cm

HEIGHTS: 1284 = 3419 cm

HEIGHTS: 1290 = 3435 cm

HEIGHTS: 1296 = 3451 cm

HEIGHTS: 1302 = 3467 cm

HEIGHTS: 1308 = 3483 cm

HEIGHTS: 1314 = 3499 cm

HEIGHTS: 1320 = 3515 cm

HEIGHTS: 1326 = 3531 cm

HEIGHTS: 1332 = 3547 cm

HEIGHTS: 1338 = 3563 cm

HEIGHTS: 1344 = 3579 cm

HEIGHTS: 1350 = 3595 cm

HEIGHTS: 1356 = 3611 cm

HEIGHTS: 1362 = 3627 cm

HEIGHTS: 1368 = 3643 cm

HEIGHTS: 1374 = 3659 cm

HEIGHTS: 1380 = 3675 cm

HEIGHTS: 1386 = 3691 cm

HEIGHTS: 1392 = 3707 cm

HEIGHTS: 1398 = 3723 cm

HEIGHTS: 1404 = 3739 cm

HEIGHTS: 1410 = 3755 cm

HEIGHTS: 1416 = 3771 cm

HEIGHTS: 1422 = 3787 cm

MARCH SHOOTING PLANT EVALUATION AND MAGNETIC RECORD MONITORING 16:23 WEDNESDAY, DECEMBER 21, 1977

HEIGHT=12 SOIL=CI MON=0

PLOT OF DAY\*CU\*V\*O LEGEND: SYMBOL USED IS C

HEIGHT  
3 = 8 cm 24 = 61 cm  
6 = 15 cm 36 = 91 cm  
9 = 23 cm  
12 = 30 cm

SOIL MON  
SA= Sand F= February  
SI= Sand & Clay J= July  
CL= Clay O= November

CULM. O  
400  
300  
200  
100  
0

CULM DENSITY culms/m<sup>2</sup>

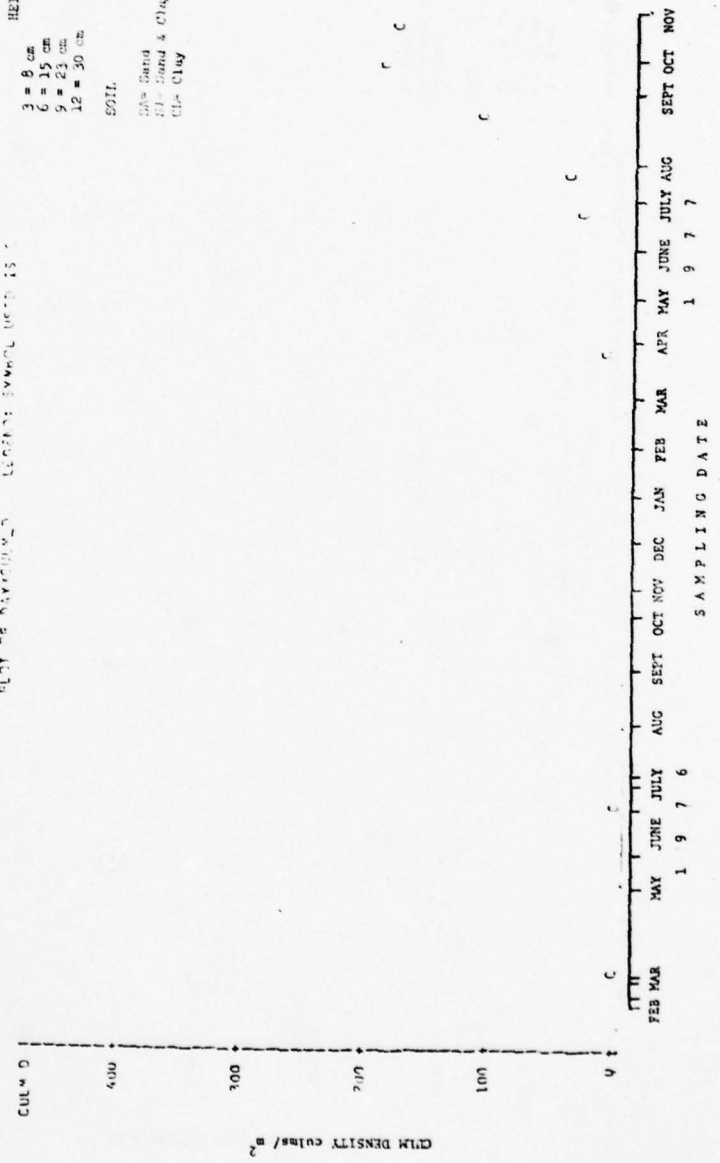
FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
1 9 7 6 1 9 7 7  
SAMPLING DATE

MARSH SODDEERING PLANT EVALUATION AND MANAGEMENT REPORT, UNIVERSITY OF  
 MISSISSIPPI, SEPTEMBER 21, 1977

HEIGHTS IN SOILS OF MARSH  
 PLANT TO DRYDOWN, LECTURE: 30000, 1000, 150

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm  
 24 = 61 cm  
 36 = 91 cm

SOIL  
 10% Sand  
 21% Sand & Clay  
 41% Clay  
 MSH  
 Feb. February  
 Jan. July  
 Oct. November



# MARSH SUCCESSION PLANT EVALUATION AND MACROINVERTEBRATE MONITORING LAKE MICHIGAN, DECEMBER 21, 1977

HEIGHT=24 CM=CL MON=J  
 PLOT OF CULM=24 LEGEND: SYMBOL USED IS C

HEIGHT  
 3 = 8 cm 24 = 61 cm  
 6 = 15 cm 36 = 91 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL MON  
 SA= Sand F= February  
 SI= Sand & Clay J= July  
 CL= Clay O= November

CULM DENSITY CULM/m<sup>2</sup>

400  
 300  
 200  
 100  
 0

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 SAMPLING DATE

# MARSH SMOTHERING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING ISRAEL WETLANDS, DECEMBER 21, 1977

HEIGHT=24 SOIL=CL MON=0  
 PLOT OF MAXIMUM D LEGEND: SYMBOL USED IS C

HEIGHT  
 3 = 8 cm 24 = 61 cm  
 6 = 15 cm 36 = 91 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL MON  
 GA= Sand P= February  
 SI= Sand & Clay J= July  
 CL= Clay O= November

CULM D  
 400  
 300  
 200  
 100  
 0

CULM DENSITY culm/m<sup>2</sup>

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 SAMPLING DATE



AD-A063 366

GEORGIA UNIV BRUNSWICK MARINE EXTENSION SERVICE

F/G 13/2

THE EFFECTS OF SMOTHERING A 'SPARTINA ALTERNIFLORA' SALT MARSH --ETC(U)

JUL 78 R J REIMOLD, M A HARDISKY, P C ADAMS

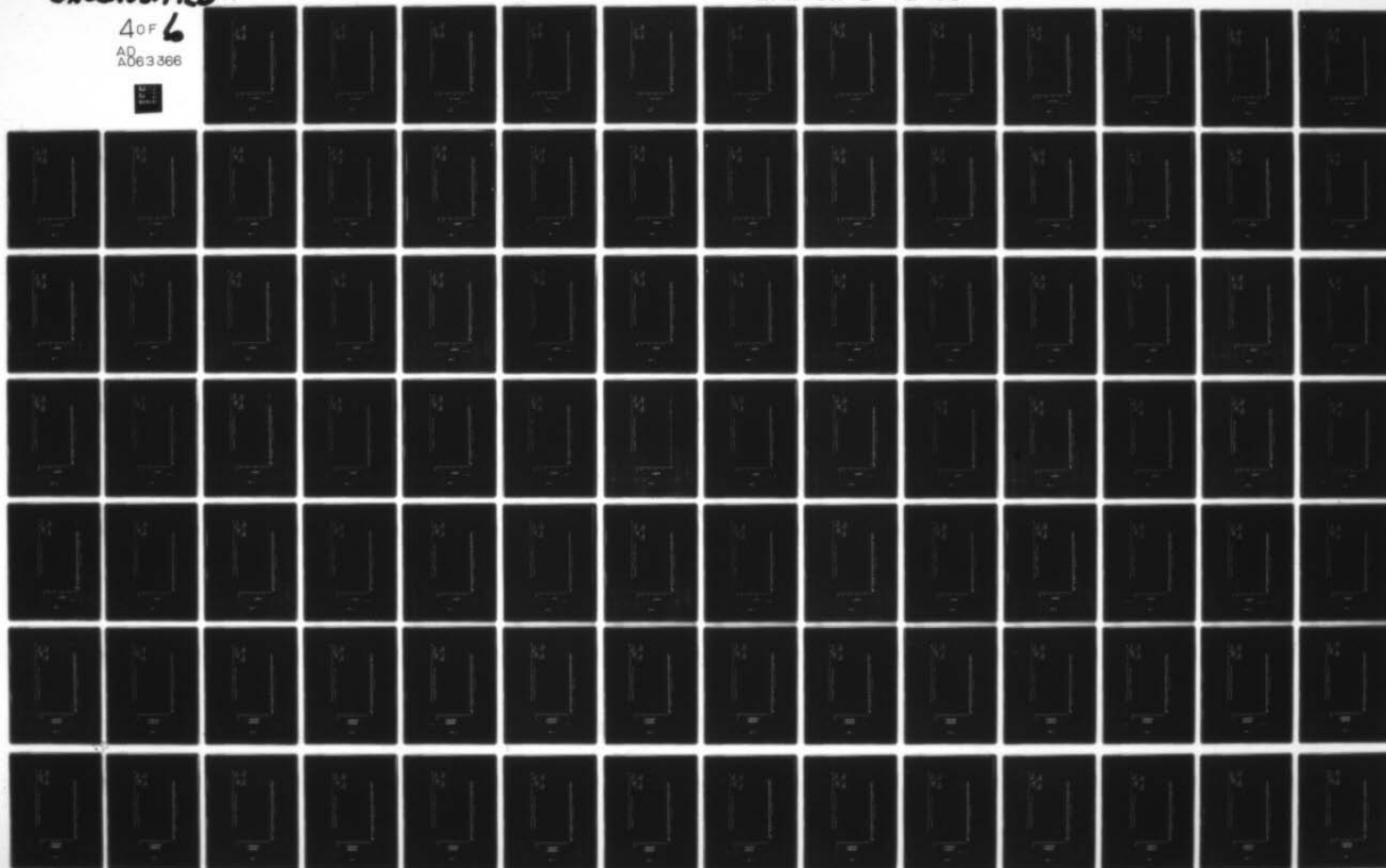
DACW21-75-C-0074

WFS-TR-D-78-38

NL

UNCLASSIFIED

40F  
AD  
A063366



4551P12

40F

6

AD

A063366



MASS SHOOTING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING  
 10122 WFOV, MAY, DECEMBER 21, 1977

HEIGHT=24 SOIL=SA MCH=2

PLOT NO DAYCUL 1.0 LEGEND: SYMPL USED IS C

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL  
 SA = Sand  
 SI = Sand & Clay  
 CL = Clay

MCH  
 F = February  
 J = July  
 O = November

CULM D

CULM DENSITY culm/m<sup>2</sup>

400  
300  
200  
100  
0

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7

SAMPLING DATE

WASH. SMITHSONIAN PLANT EVALUATION AND MACROINVERTEBRATE MONITORING 16:03 WEDNESDAY, FEBRUARY 21, 1977

HEIGHT: 100 cm

PLANT OF DOMESTIC USE: LEGUMINOSAE

HEIGHT  
3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 23 cm

MON

Soil  
Dry Sand  
Wet Sand & Clay  
Clay Clay

CLIM # 0

400

300

200

100

0

CLIM DENSITY column #

FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12  
SAMPLING DATE

WINDS SWOOSHING OVERHEADS, HEARD  
 ABOUT 21, 1977

76 = 261944  
75 = 7105  
74 = 1026

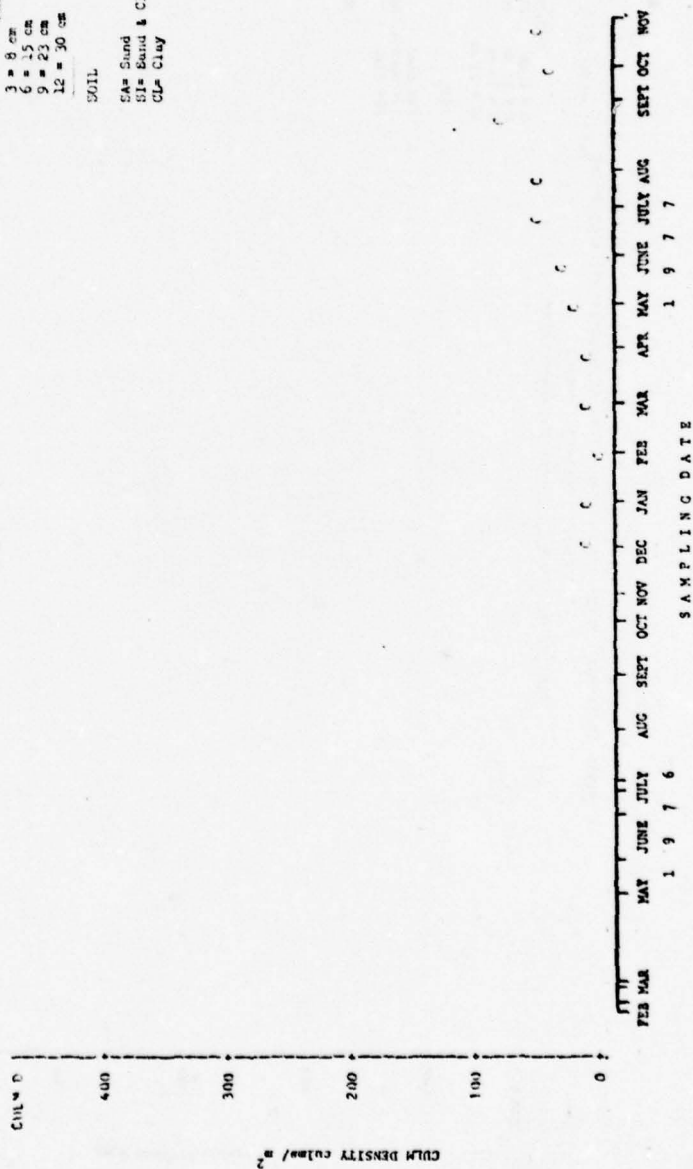
PL07 DE 04V-CULM-  
LEEND: SYMOL 050 15 0

HEIGHT

$3 = 8 \text{ cm}$        $2\frac{1}{2} = 6\frac{1}{2} \text{ cm}$   
 $6 = 15 \text{ cm}$        $36 = 91 \text{ cm}$   
 $9 = 23 \text{ cm}$   
 $12 = 30 \text{ cm}$

**NOTE**

SA= Sand  
SI= Sand & Clay  
CL= Clay







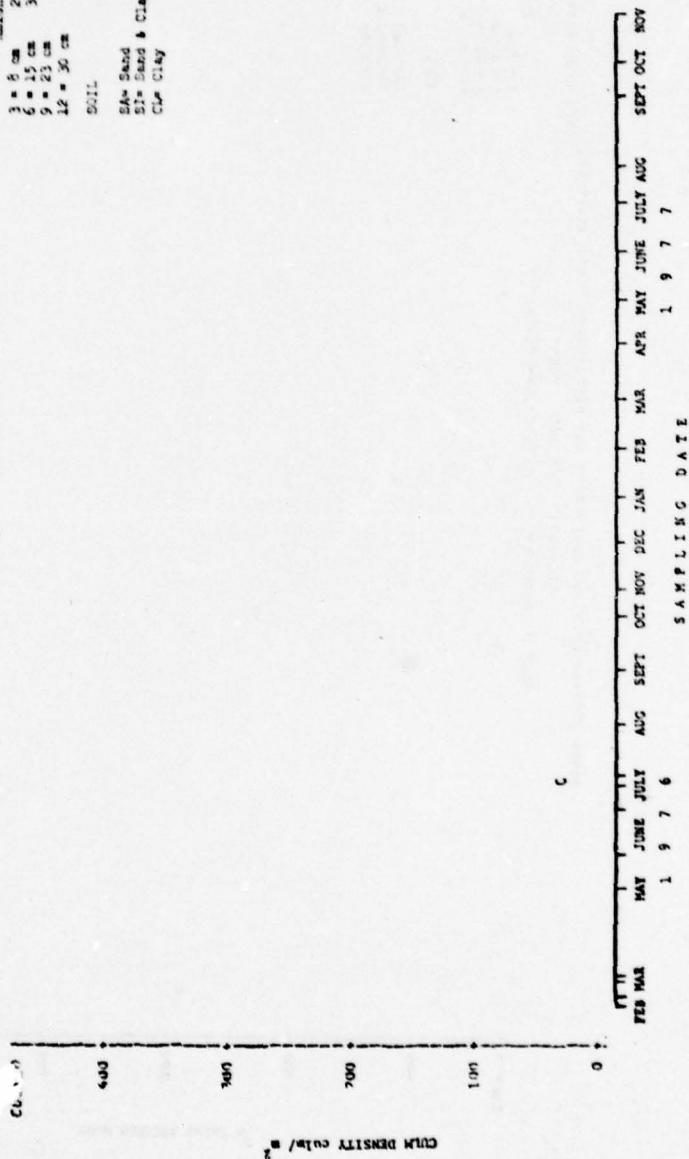
MASS SMOOTHING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING  
 1973 WEDN. SOAY, DECEMBER 21, 1977

HEIGHTS COLLECTED MONDAY  
 PLOT OF PLANTING LEGEND: SYMBOL USED IS C

HEIGHT  
 3 = 6 cm 24 = 61 cm  
 6 = 15 cm 36 = 91 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL  
 S1 = Sand  
 S2 = Sand & Clay  
 C1 = Clay

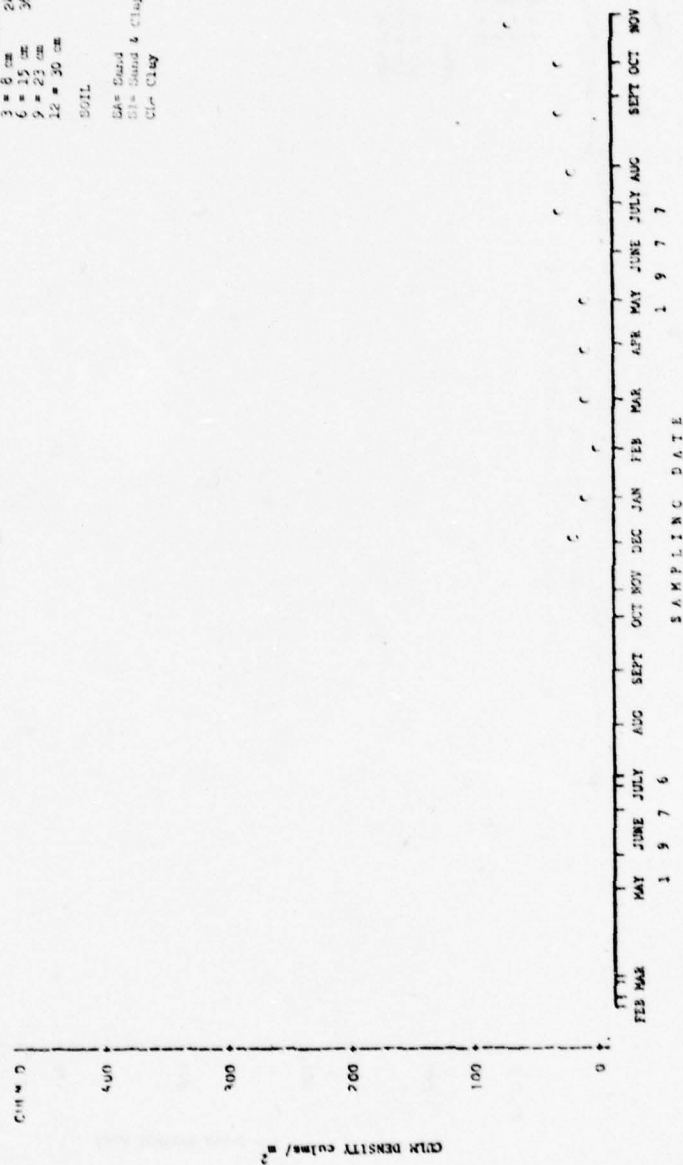
MOB  
 F = February  
 J = July  
 O = November



0679-0000  
0679-0000

$3 = 6 \text{ cm}$   
 $6 = 15 \text{ cm}$   
 $9 = 23 \text{ cm}$   
 $12 = 30 \text{ cm}$

DOIL	WCS	
EA= Sand	Feb= February	
CL= Sand & Clay	Jul= July	
CL= Clay	Nov= November	



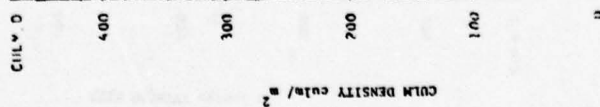
WASH. STATE PLANT EVALUATION AND MACROINVERTEBRATE MONITORING  
 10:00 MONDAY, DECEMBER 21, 1977

HEIGHT: 36 CM, CIL: 100 CM

PLOT OF CUMULATIVE DENSITY USED IS C

HEIGHT: 61 cm  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL: MOE  
 1st Sand  
 2nd Sand & Clay  
 3rd Clay

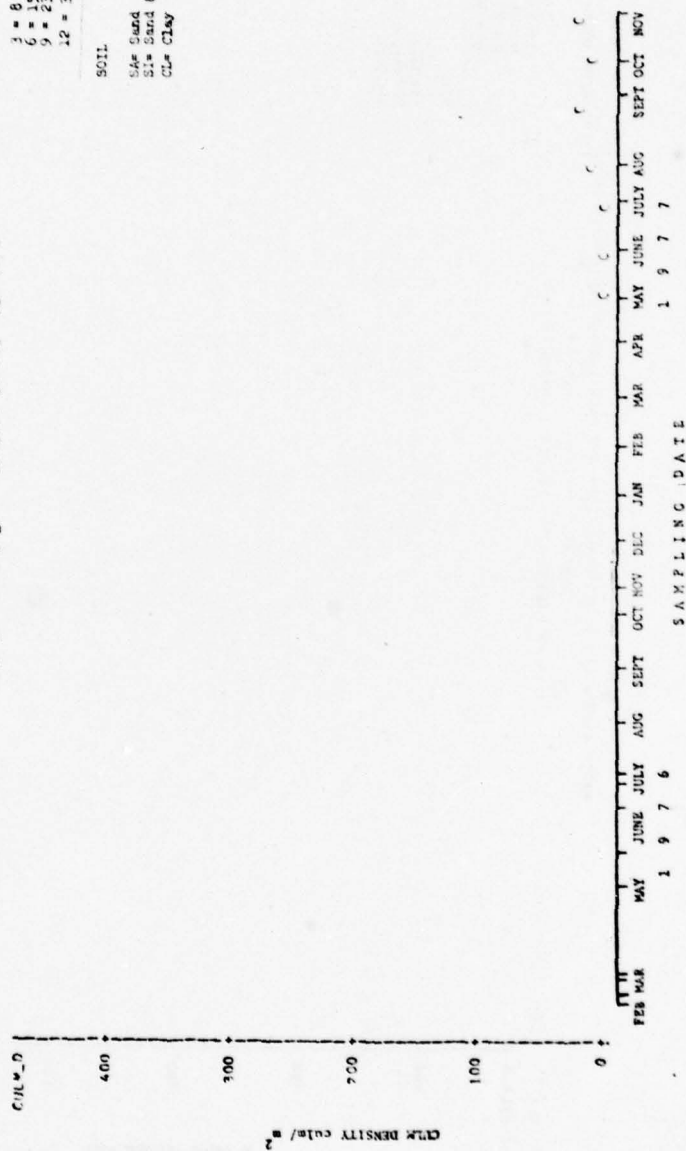


B78

081-0511760AS : UNCOR  
FACOM TONICS 96=100134

	HEIGHT
3	8 cm
6	15 cm
9	23 cm
12	30 cm
24	61 cm
36	91 cm

SOIL. MON F= February  
J= July  
O= November





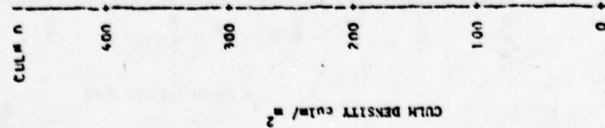
WASH SAMPLING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING 16:23 WEDNESDAY, DECEMBER 21, 1977

WRIGHTSON REFLECT MWD

PLOT OF DENSITY vs C

HEIGHT  
3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

SOIL  
Silt  
Silt & Sand  
Silt & Sand & Clay  
Clay  
MWD  
1st February  
2nd July  
3rd November



B80

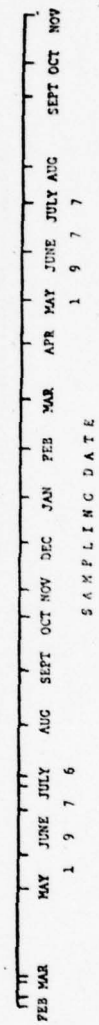
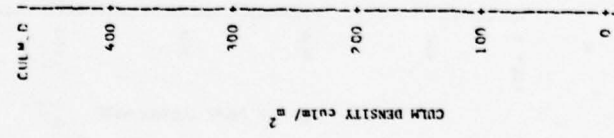
WASH SWAMPING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING  
 16:23 MONDAY, December 21, 1978

HEIGHT=36 SOIL=SA MCH=6  
 PLOT OF DAY=CULM\_C LEGEND: SYMBOL USED IS C

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm  
 24 = 61 cm  
 36 = 91 cm

SOIL  
 SA = Sand  
 SA = Sand & Clay  
 CL = Clay

MOON  
 Fe February  
 Ju July  
 No November



[illegible]

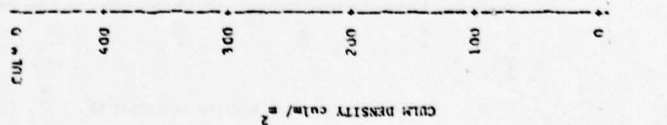
## HEIGHT

3 = 6 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

7105

## CON

SA= Sand  
 SL= Sand & Clay  
 CL= Clay



2 CULM DENSITY culm/m<sup>2</sup>

II		SAMPLING DATE																				
		MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV
FEB	MAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

B83

MARSH SMOTHERING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING 1623 MONUMENT AVE, DECEMBER 21, 1973

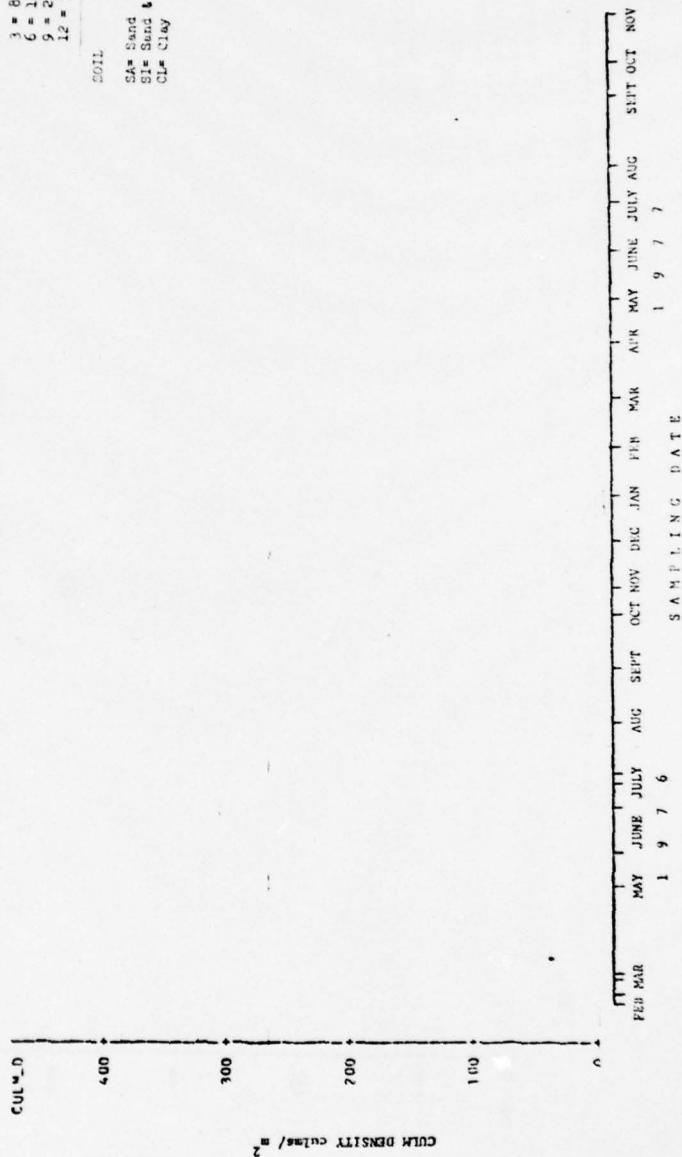
HEIGHT=36, CUL=01 MCN=0

FLY OF DAY=CULM\_D LEGEND: SYMBOL USED IS :

HEIGHT	3 = 8 cm	24 = 61 cm
	6 = 15 cm	36 = 91 cm
	9 = 23 cm	
	12 = 30 cm	

SOIL	MCN
SA = Sand	Fe = February
SL = Sand & Clay	Ja = July
CL = Clay	On = November



[illegible][illegible]

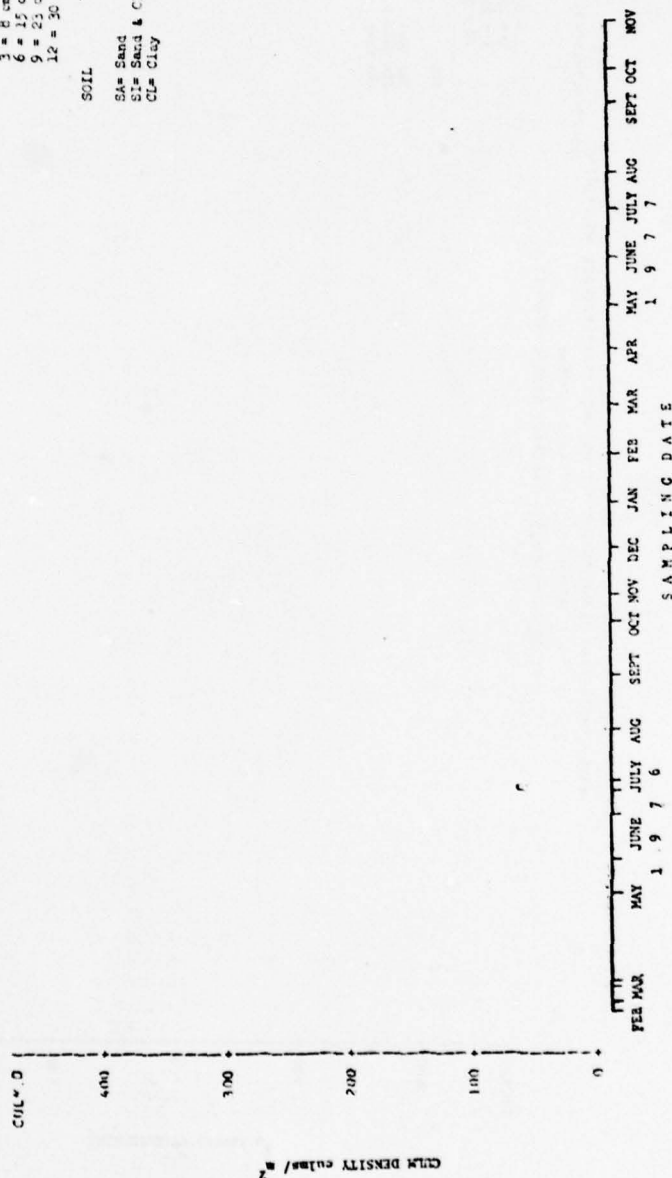
3 = 9 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm  
 15 = 36 cm  
 18 = 45 cm  
 24 = 61 cm

SOIL                      MON

SA= Sand                      F= February

SI= Sand & Clay              J= July

CL= Clay                      O= November





WASH CROSSLING PLANT EVALUATION AND VACUUMFEEDBACK MONITORING 16:23 MONDAY, 21. 1977

HEIGHTS COLLECT MONDAY

PLANT OF CROSSLING LFCEN: SYMBOL USED IS C

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm  
 24 = 61 cm  
 36 = 91 cm

SOIL

MON

SW= Sand  
 ST= Sand & Clay  
 CL= Clay  
 P= February  
 J= July  
 O= November

CUMULATIVE  
 400  
 300  
 200  
 100  
 0

CUM DENSITY CUMULATIVE

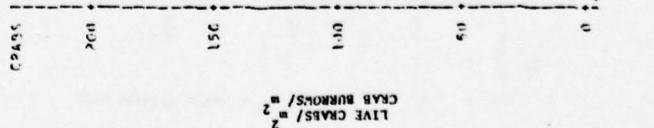
FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 SAMPLING DATE

WATER SAMPLING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING  
 1623 WEDGEMAN, AUGUST 21, 1977

SOIL = M<sub>1</sub> =  
 PLOT OF DAY-SPRING LEGEND: SYMBOL USED IS CHARACTER C  
 PLOT OF DAY-SUMMER LEGEND: SYMBOL USED IS CHARACTER B

HEIGHT  
 3 = 8 cm 24 = 61 cm  
 6 = 15 cm 36 = 91 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL MON  
 S<sub>1</sub> = Sand F = February  
 S<sub>2</sub> = Sand & Clay J = July  
 C<sub>1</sub> = Clay O = November

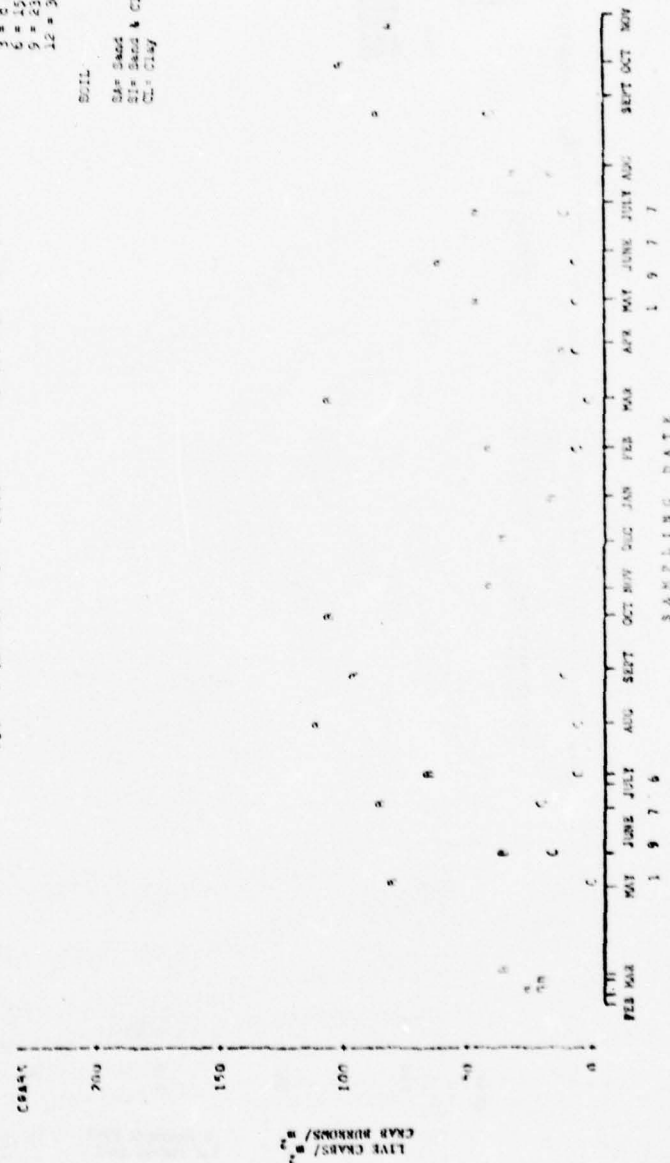


FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 SAMPLING DATE

[illegible]

3	=	6	=	36	=	27	=	36	=	36
6	=	15	=	36	=	15	=	36	=	36
9	=	23	=	36	=	23	=	36	=	36
24	=	36	=	36	=	36	=	36	=	36

SOIL	MEM	
Sa: Sand		Pa: February
Si: Sand & Clay		Ja: July
Cl: Clay		Ca: November

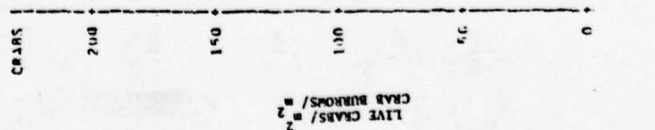


WILSON CRABBER PLANT INVESTIGATION AND WADSWORTH CRABBER PLANT INVESTIGATION 16123 WADSWORTH, SUCCESS 21, 1977

HEIGHT 33 SOIL (CL MONS)  
 PLANT OF CRABBERS 150000 SWOOL USED 18 CRABBERS 6  
 PLANT OF CRABBERS 150000 SWOOL USED 18 CRABBERS 6

HEIGHT  
 3 = 6 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm  
 24 = 61 cm  
 36 = 91 cm

SOIL  
 MJS  
 S1 = Sand  
 S1 = Sand & Clay  
 C1 = Clay  
 F = February  
 J = July  
 O = November



SAMPLING DATE

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7

WASH. STATE COAST GUARD EVALUATION AND "MACROINVERTEBRATE MONITORING" JACOB WEDENSOLOV, DECEMBER 21, 1977

HEIGHTS: 3000 FT. MWD

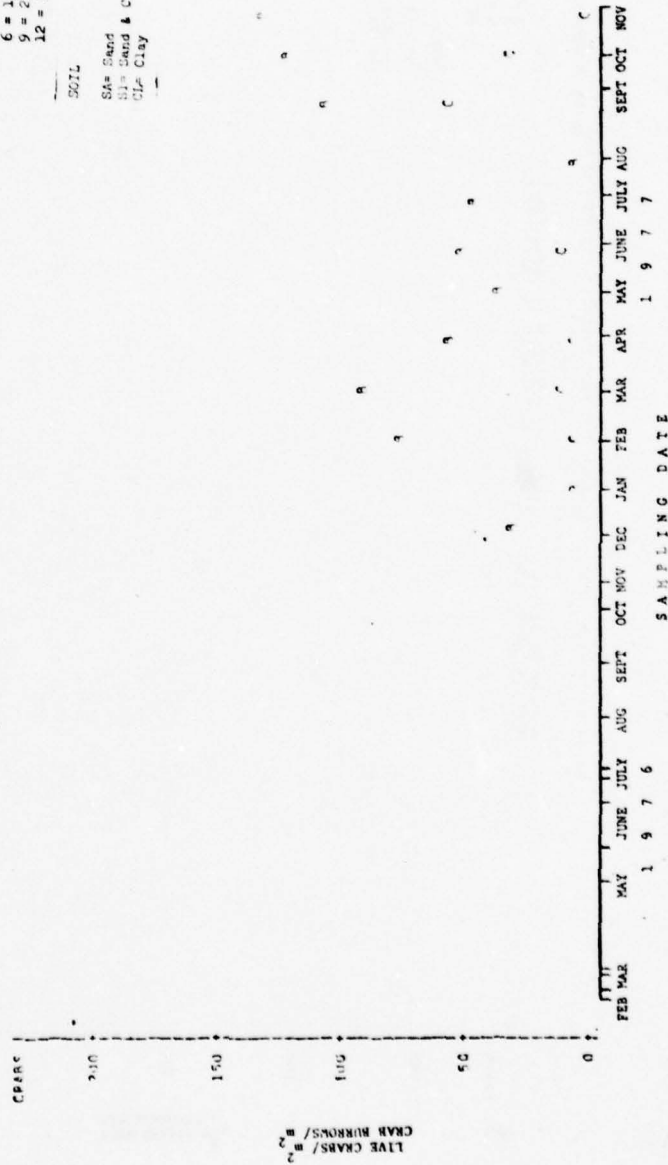
PLANT OF MACROINVERTEBRATE MONITORING USED IS CHARACTERISTIC

HEIGHT  
3 = 8 cm  
6 = 13 cm  
9 = 23 cm  
12 = 30 cm

SOIL

MEAN

Silt Sand  
Silt Sand & Clay  
Clay Clay  
Feb. February  
Jul. July  
Nov. November





MARCH SAMPLING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING, 1977 WEDNESDAY, DECEMBER 21, 1977

HEIGHTS: 24 = 61 cm  
9 = 23 cm  
9 = 23 cm  
12 = 30 cm

HEIGHT  
24 = 61 cm  
9 = 23 cm  
9 = 23 cm  
12 = 30 cm

SOIL  
A = Sand  
S = Sand & Clay  
CL = Clay

MOON

F = February  
J = July  
O = November

CRAPS

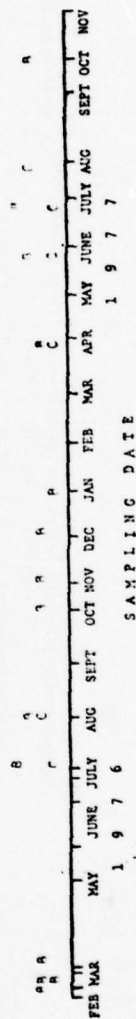
200

150

100

50

LIVE CRABS/  
CHAB BURROWS / m<sup>2</sup>

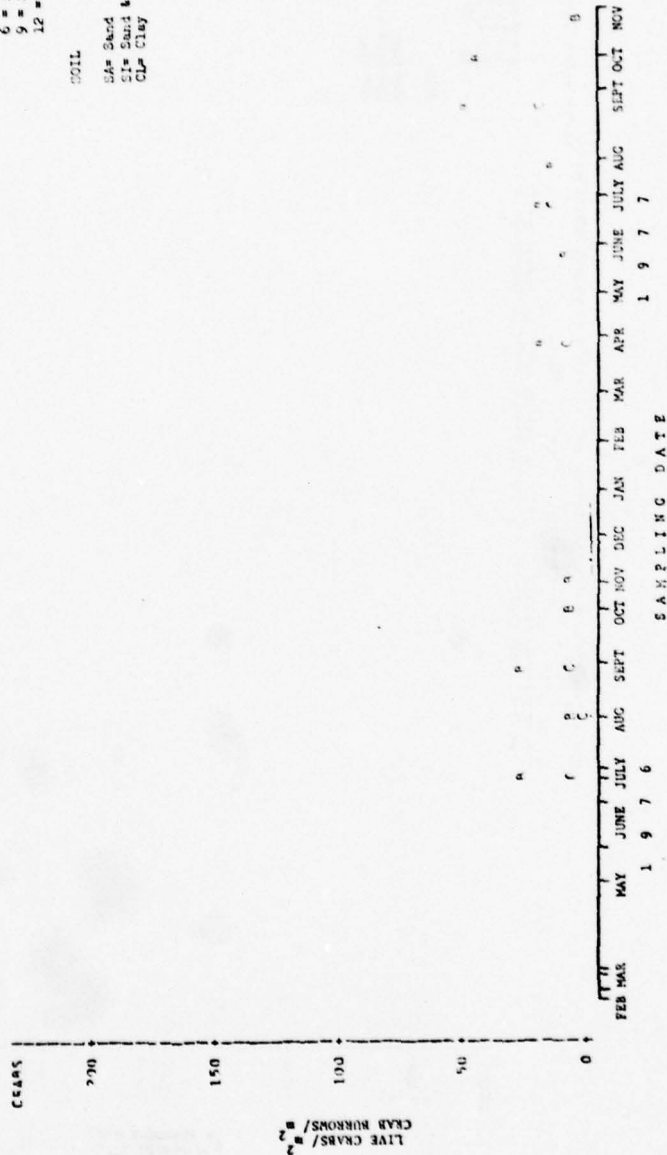


# WATER MONITORING PLANT EVALUATION AND MONITORING STATION MONITORING 10123 MEDICAL, MEDICAL 11, 1977

PERFORMED COLLECTA MONITORING  
 PLANT OF DAY 1977 MONITORING STATION MONITORING 10123 MEDICAL, MEDICAL 11, 1977  
 PLANT OF DAY 1977 MONITORING STATION MONITORING 10123 MEDICAL, MEDICAL 11, 1977

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

MOON  
 1st Quarter  
 2nd Quarter  
 3rd Quarter  
 4th Quarter





MARCH 1977  
 1000 WESTERN AVENUE, CHICAGO, ILL. 60606

WATER COLLECTOR NAME  
 PLANT OF ORIGIN  
 PLANT OF ORIGIN

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL  
 100 = Sand  
 110 = Sand & Clay  
 120 = Clay

COARS

200

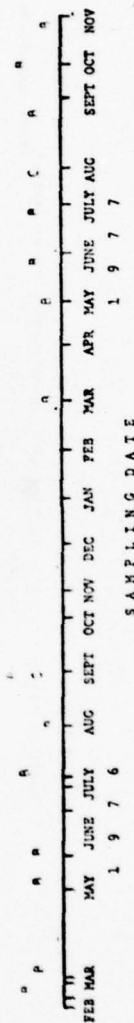
150

100

50

0

LIVE CHARS/2  
 CHAR BURROWS/2



$\Gamma = \text{CUM} \quad L_0 = 11.75 \quad C_2 = 6.90$

PLOT  
PLOT  
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CF  
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YBY  
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YBY

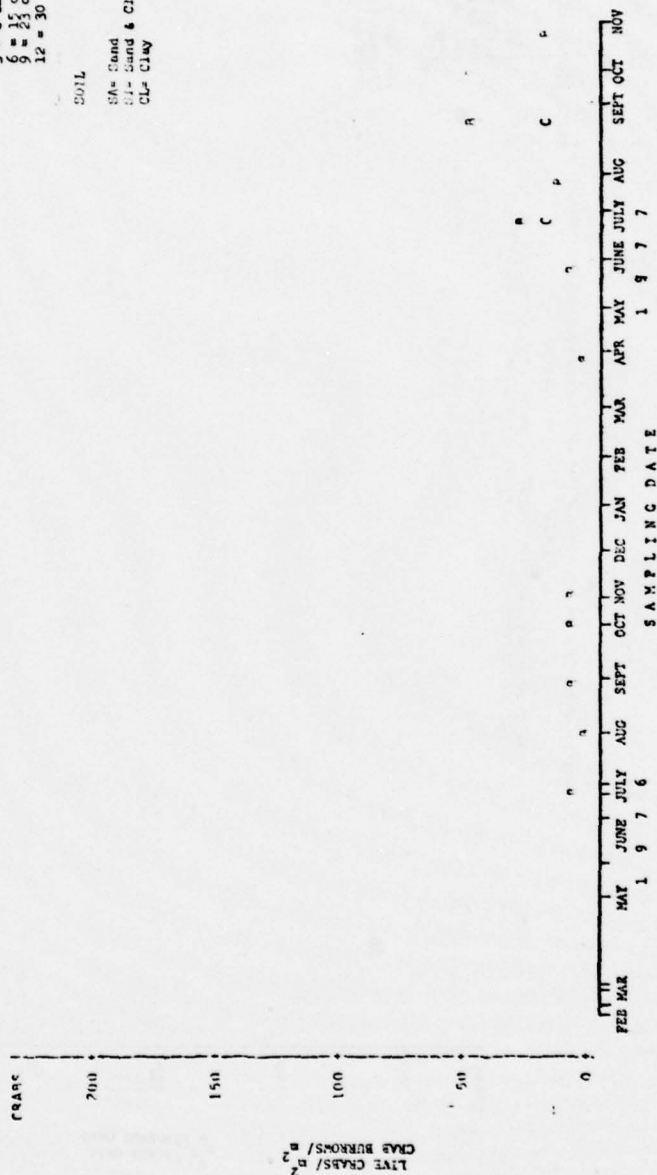
WEIGHT

$$\begin{array}{rcl} 3 & = & 8 \text{ cm} \\ 6 & = & 13 \text{ cm} \\ 9 & = & 23 \text{ cm} \\ 12 & = & 30 \text{ cm} \end{array}$$

7105

# HOW

F= February  
 J= July  
 O= November





WASH STATE PLANT MATERIALS AND MARK INVESTIGATION, 1973-1974, 1977

HEIGHTS: 2000, 2000, 2000

PLANT OF DAY: 1973-1974, 1977

HEIGHT  
3 = 6 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

SOIL

2000 Sand  
2000 Sand & Clay  
2000 Clay

0  
50  
100  
150  
200  
250

LIVE CRABS / m<sup>2</sup>  
CHAB BURROWS / m<sup>2</sup>

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
1 9 7 6 1 9 7 7

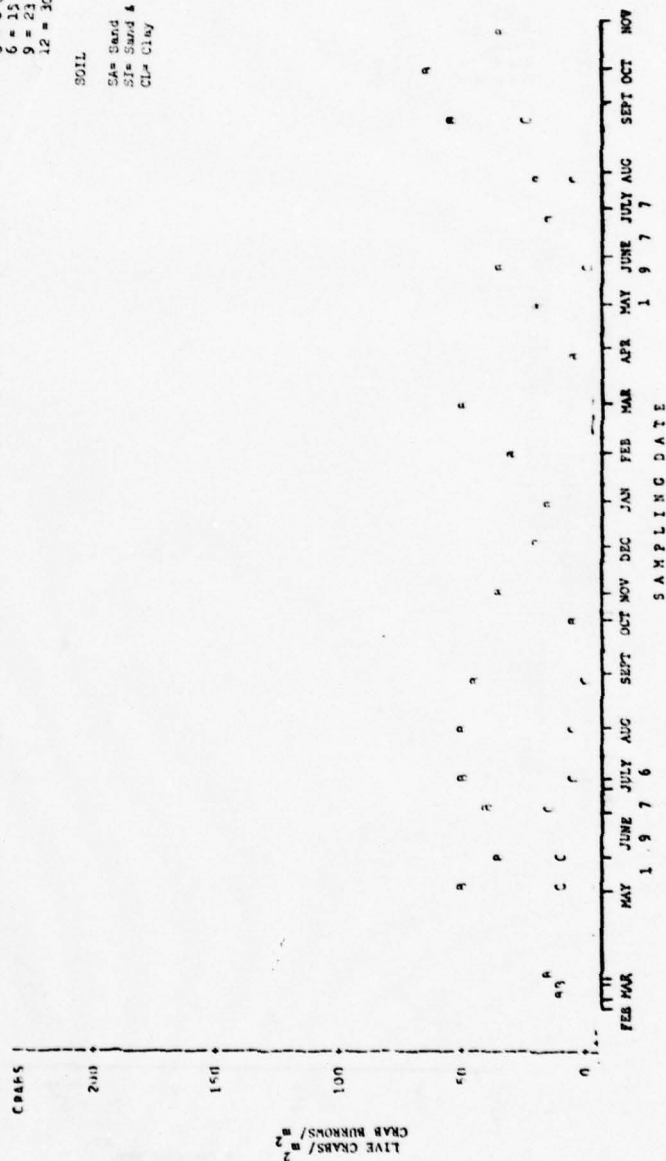
SAMPLING DATE

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 -100

MEZ.GH<sup>2</sup>

3 = 6 cm	24 = 61 cm
6 = 15 cm	36 = 91 cm
9 = 23 cm	
12 = 30 cm	

SOIL	MOE
SA= Sand	F= February
SI= Sand & Clay	J= July
CL= Clay	C= November



# WATER SAMPLING PLANT EVALUATION AND WATER QUALITY MONITORING LAKE SUPERIOR, 1975

WATER QUALITY MONITORING  
 PLANT OF CHESAPEAKE REGIONAL WATER TREATMENT PLANT  
 PLANT OF CHESAPEAKE REGIONAL WATER TREATMENT PLANT

HEIGHT  
 3 = 6 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

MON

Feb. February  
 Mar. March  
 Apr. April  
 May. May  
 Jun. June  
 Jul. July  
 Aug. August  
 Sept. September  
 Oct. October  
 Nov. November

CRAB  
 200  
 150  
 100  
 50  
 0

LIVE CRABS / m<sup>2</sup>

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7

SAMPLING DATE

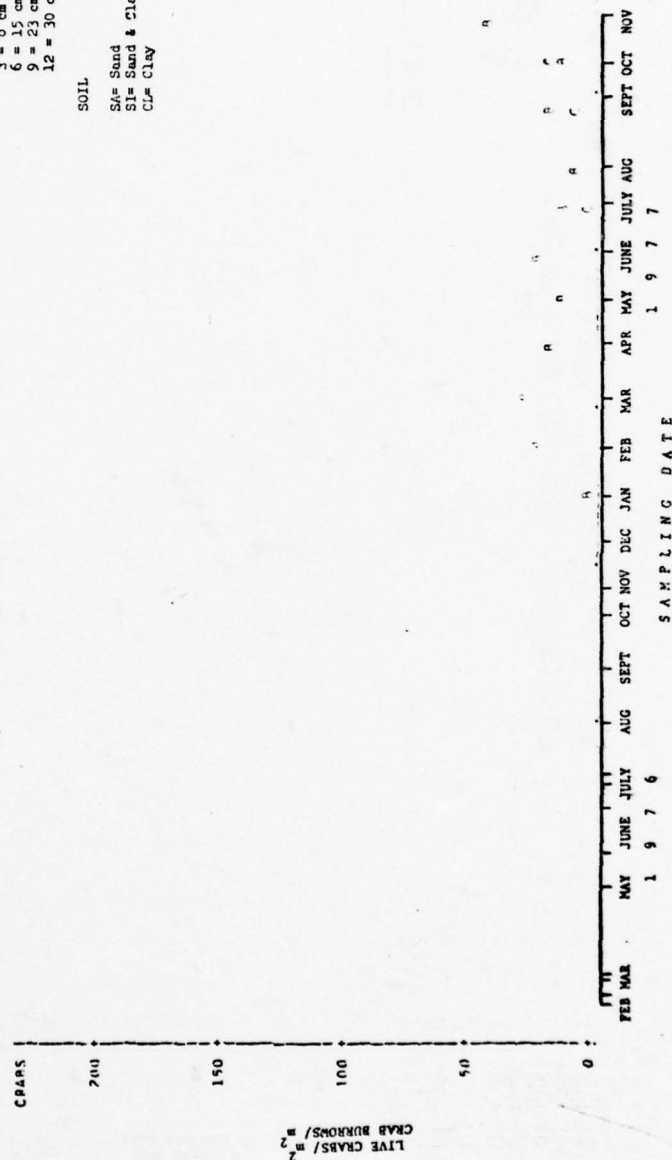
MARSH DROPPING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING  
16:23 WEDNESDAY, JULY 21, 1977

PLANT OF DAY: *Phragmites communis* L. (POPPLE) IS CHARACTERISTIC

HEIGHT  
3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

SOIL  
S1 = Sand  
S2 = Sand & Clay  
C1 = Clay

MOON  
P = February  
J = July  
O = November

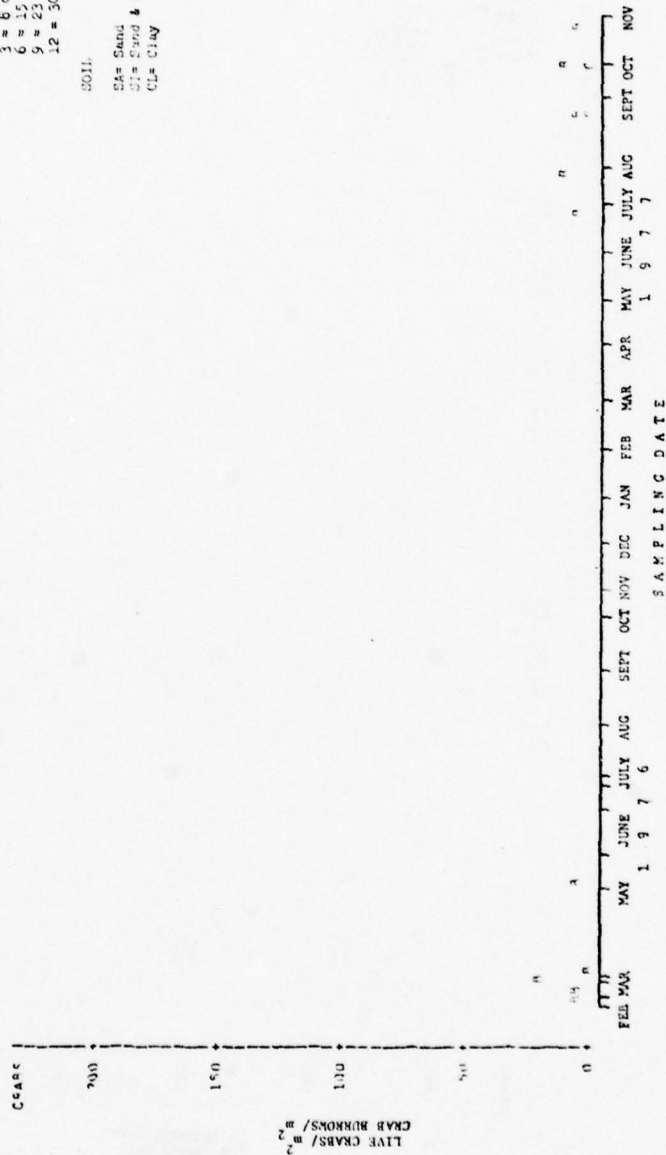


WATER CONSTRUCTION PLANT UTILIZATION AND MACROINVERTEBRATE MONITORING  
 16:23 W. 1000 S.D.V. 20/21/22, 1977

HEIGHT OF RAY-CORALS  
 HEIGHT OF RAY-CORALS  
 HEIGHT OF RAY-CORALS

HEIGHT  
 3 = 6 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL  
 CL = Sand  
 CL = Sand & Clay  
 CL = Clay  
 MUR  
 F = February  
 J = July  
 O = November







WASH. STATE UNIV. DEPT. OF AGRICULTURE AND MECHANICAL ENGINEERING  
 1600 N. 2ND ST., PULLMAN, WASH. 99163

PLANT GROWTH RECORDS  
 1968-1969  
 1968-1969  
 1968-1969

HEIGHT  
 2 = 8 cm  
 4 = 21 cm  
 6 = 21 cm  
 12 = 30 cm

SOIL  
 1 = Sand  
 2 = Sand & Clay  
 3 = Clay  
 4 = February  
 5 = July  
 6 = November

CRAB  
 200  
 150  
 100  
 50  
 0

LIVE CRABS / m<sup>2</sup>  
 CRAB BURROWS / m<sup>2</sup>

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7

SAMPLING DATE

MARSH SNOTHERING PLANT SALINITY AND MACROINVERTEBRATE MONITORING 16:23 W. M. S. C. A. V. 21. 1977

WETLANDS COLLECT MCH 77

PLOT OF DRY-CELLSUS LEGEND: SWAMP USED IS CHARACTER 6

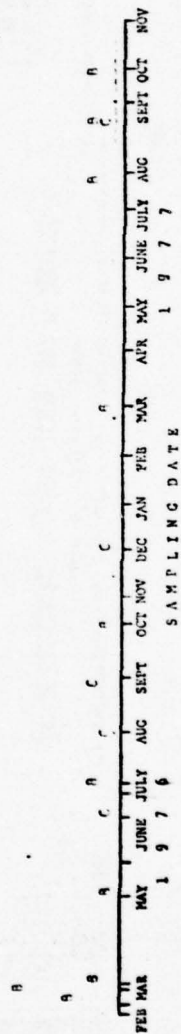
HEIGHT  
3 = 8 cm 24 = 61 cm  
6 = 15 cm 36 = 91 cm  
9 = 23 cm  
12 = 23 cm

SOIL MCN

EA= Sand F= February  
SI= Sand & Clay J= July  
CL= Clay O= November

CRABS  
200  
150  
100  
50  
0

LIVE CRABS/  
CRAB BURROWS/ = 2



B102

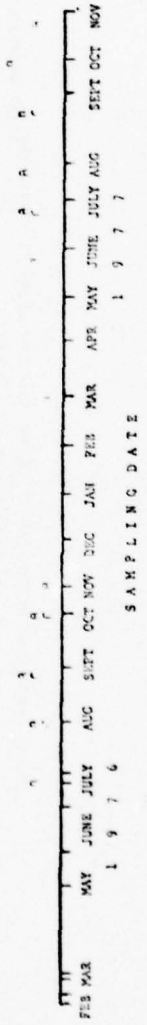
B103

MASSACHUSETTS DEPARTMENT OF AGRICULTURE, BOSTON, MASS., SEPTEMBER 21, 1977

TO: THE DIRECTOR, U.S. DEPARTMENT OF AGRICULTURE, WASHINGTON, D.C.  
FROM: THE DIRECTOR, MASSACHUSETTS DEPARTMENT OF AGRICULTURE, BOSTON, MASS.

RE: CRAB MARKERS  
HEIGHT  
3 = 6 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm  
24 = 61 cm  
36 = 91 cm  
SOIL  
MON  
1st = Sand  
2nd = Sand & Clay  
3rd = Clay  
Feb. February  
Jul. July  
Nov. November

LIVE CRABS / m<sup>2</sup>  
CRAB MARKERS / m<sup>2</sup>  
0  
50  
100  
150  
200  
250

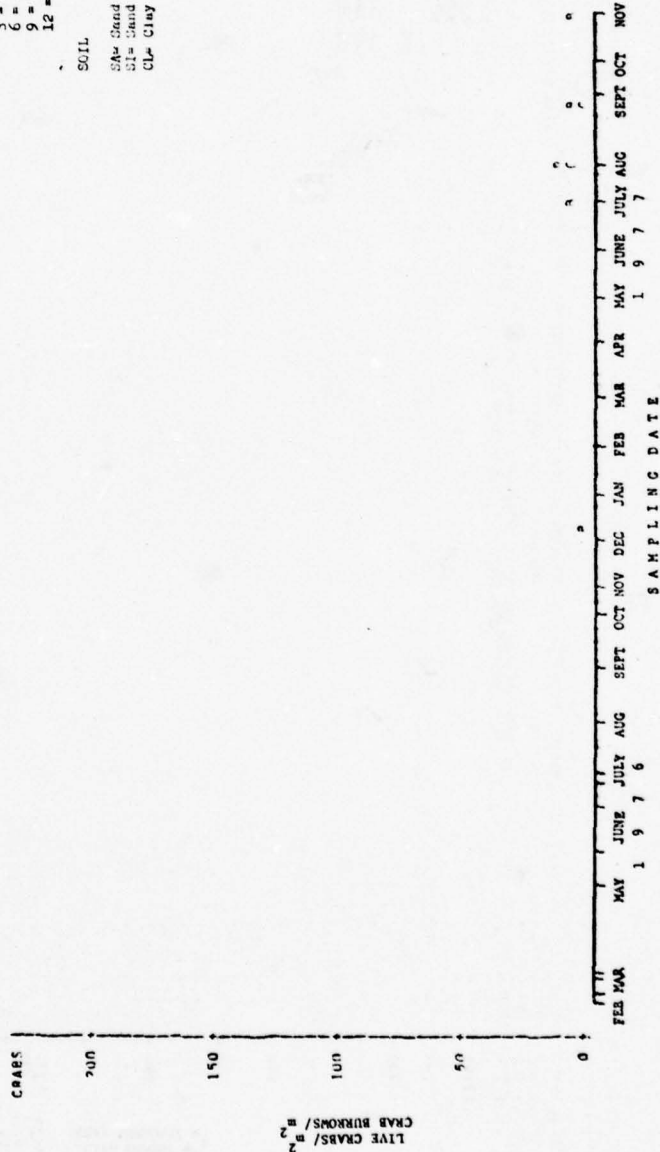


MARSH SNOWSHED PLANT SIMULATION AND MACHINERY MONITORING 1973 WEDNESDAY, December 21, 1977

HEIGHT 66 SOIL 51 MO 100  
 PLANT OF DAY/CRAB LEGEND: SYMBOL USED IS CHARACTER 2  
 PLANT OF DAY/CRAB LEGEND: SYMBOL USED IS CHARACTER 2

HEIGHT  
 3 = 8 cm 24 = 61 cm  
 6 = 15 cm 36 = 91 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL  
 S1 = Sand  
 S2 = Sand & Clay  
 CL = Clay  
 MO = February  
 J = July  
 O = November



B104



B105

MASSACHUSETTS BUREAU OF PLANT INDUSTRY AND HORTICULTURE, 200 WEST STREET, BOSTON, MASS. 02108, OCTOBER 21, 1977

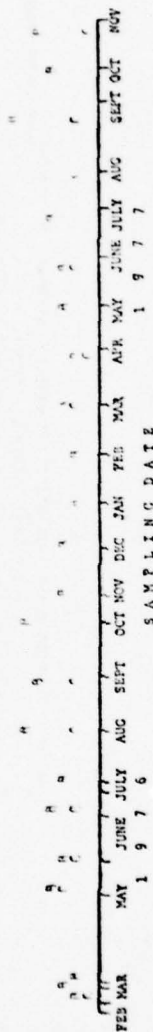
PLANT OF THE YEAR 1977: LEGUME (SWING) 1977 IS CONSIDERED A

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL  
 S1 = Sand  
 S2 = Sand & Clay  
 CL = Clay  
 M = February  
 J = July  
 N = November

0  
 50  
 100  
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 3050  
 3100  
 3150  
 3200  
 3250  
 3300  
 3350  
 3400  
 3450  
 3500  
 3550  
 3600  
 3650  
 3700  
 3750  
 3800  
 3850  
 3900  
 3950  
 4000  
 4050  
 4100  
 4150  
 4200  
 4250  
 4300  
 4350  
 4400  
 4450  
 4500  
 4550  
 4600  
 4650  
 4700  
 4750  
 4800  
 4850  
 4900  
 4950  
 5000  
 5050  
 5100  
 5150  
 5200  
 5250  
 5300  
 5350  
 5400  
 5450  
 5500  
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 5600  
 5650  
 5700  
 5750  
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 5950  
 6000  
 6050  
 6100  
 6150  
 6200  
 6250  
 6300  
 6350  
 6400  
 6450  
 6500  
 6550  
 6600  
 6650  
 6700  
 6750  
 6800  
 6850  
 6900  
 6950  
 7000  
 7050  
 7100  
 7150  
 7200  
 7250  
 7300  
 7350  
 7400  
 7450  
 7500  
 7550  
 7600  
 7650  
 7700  
 7750  
 7800  
 7850  
 7900  
 7950  
 8000  
 8050  
 8100  
 8150  
 8200  
 8250  
 8300  
 8350  
 8400  
 8450  
 8500  
 8550  
 8600  
 8650  
 8700  
 8750  
 8800  
 8850  
 8900  
 8950  
 9000  
 9050  
 9100  
 9150  
 9200  
 9250  
 9300  
 9350  
 9400  
 9450  
 9500  
 9550  
 9600  
 9650  
 9700  
 9750  
 9800  
 9850  
 9900  
 9950  
 10000

LIVE CRAWNS/  
 CRAWN RUNNERS/



B106

WATER SURVEILLING PLANT, WASHINGTON AND MARSHALL ISLANDS, 1955-1956

PLANT OF MARSHALL ISLANDS, MARSHALL ISLANDS, 1955-1956

HEIGHT

3 = 8 cm 24 = 61 cm  
6 = 15 cm 36 = 91 cm  
9 = 23 cm  
12 = 30 cm

SOIL

24 = Sand  
36 = Sand & Clay  
48 = Clay  
60 = February  
72 = July  
84 = November

LIVE CRABS / m<sup>2</sup>  
200  
150  
100  
50  
0

CRABS

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
1 9 7 6 1 9 7 7

SAMPLING DATE

MASSIVE FACIOLATED PLATE THERMOCYSTES, FOR MICROSCOPIC STUDY. 10.125 N. DRY SLURRY. 7.5 CM. 21. 1977

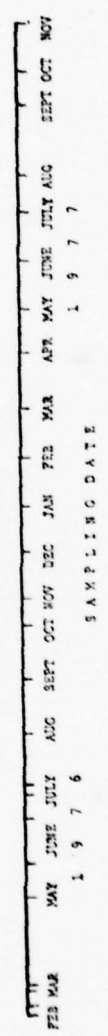
MASSIVE FACIOLATED PLATE THERMOCYSTES, FOR MICROSCOPIC STUDY. 10.125 N. DRY SLURRY. 7.5 CM. 21. 1977

PLATE THERMOCYSTES, FOR MICROSCOPIC STUDY. 10.125 N. DRY SLURRY. 7.5 CM. 21. 1977

HEIGHT  
3 = 8 cm 24 = 61 cm  
6 = 15 cm 36 = 91 cm  
9 = 23 cm  
12 = 30 cm

SOIL  
Thin Sand  
Thin Sand & Clay  
Clay  
Feb February  
Jan July  
Oct November

LIVE CRABS / m<sup>2</sup>  
CRAB BURROWS / m<sup>2</sup>

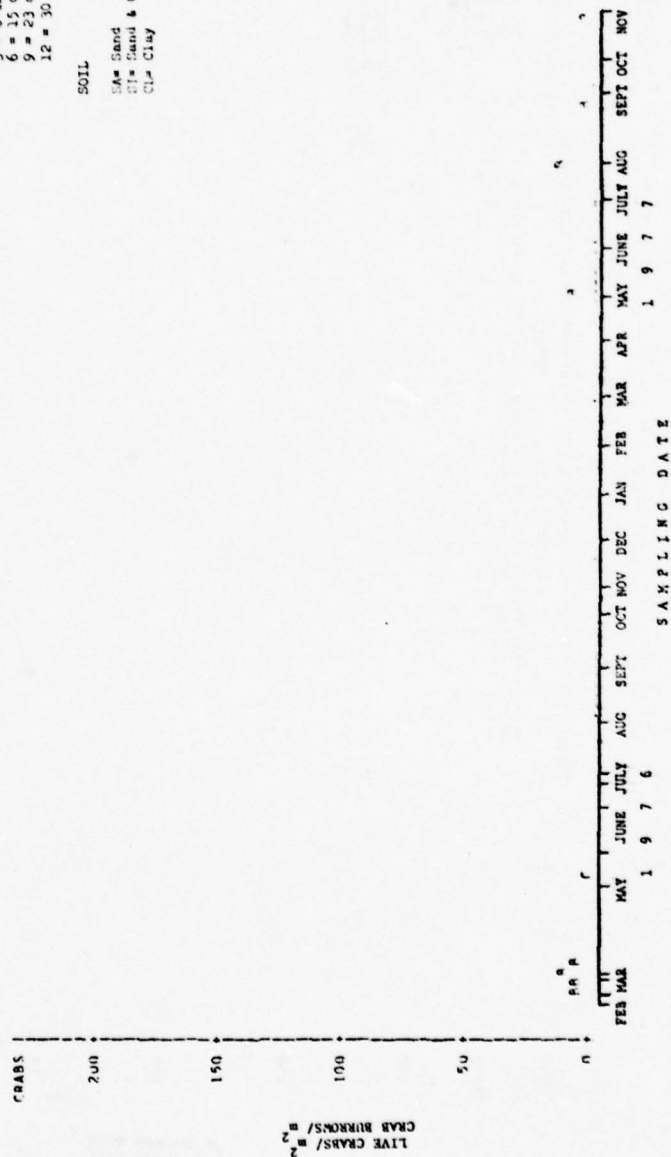


MARSH SMOOTHED PLANT EVALUATION AND MACHINERY MONITORING LOSS MON. SWAY, 21, 1977

HEIGHT MON. SWAY  
 PLANT OF DAY: CRABS  
 PLANT OF DAY: CRABS  
 PLANT OF DAY: CRABS

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm  
 24 = 61 cm  
 36 = 91 cm

SOIL  
 SA = Sand  
 ST = Sand & Clay  
 CL = Clay  
 MCN  
 1 = February  
 2 = July  
 3 = November



B108

B109

WADSWORTH COUNTY, CALIFORNIA AND MARSHES OF THE SAN JOAQUIN VALLEY, 1917

WADSWORTH COUNTY, CALIFORNIA

PLANT OF DAY CROSSLAND (SANDHILL) 12 FEBRUARY 1917

HEIGHT  
3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

SOIL  
SAND  
SAND & CLAY  
CLAY

MOON  
2 = February  
3 = July  
4 = November





MADE BY THE BUREAU OF AGRICULTURE, DEPT. OF AGRICULTURE, WASHINGTON, D.C. 20250, 21. 1977

HEIGHT 24 = 61 cm  
36 = 91 cm  
48 = 121 cm  
60 = 151 cm  
72 = 181 cm  
84 = 211 cm  
96 = 241 cm  
108 = 271 cm  
120 = 301 cm

HEIGHT  
24 = 61 cm  
36 = 91 cm  
48 = 121 cm  
60 = 151 cm  
72 = 181 cm  
84 = 211 cm  
96 = 241 cm  
108 = 271 cm  
120 = 301 cm

3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

SOIL  
S1 = Sand  
S2 = Sand & Clay  
C1 = Clay  
M1 = February  
J1 = July  
O1 = November

CRACKS  
200  
150  
100  
50  
0

LIVE CRACKS /  $m^2$   
CLAS BIRKHOUS /  $m^2$

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
1 9 7 6 1 9 7 7  
SAMPLING DATE

B110

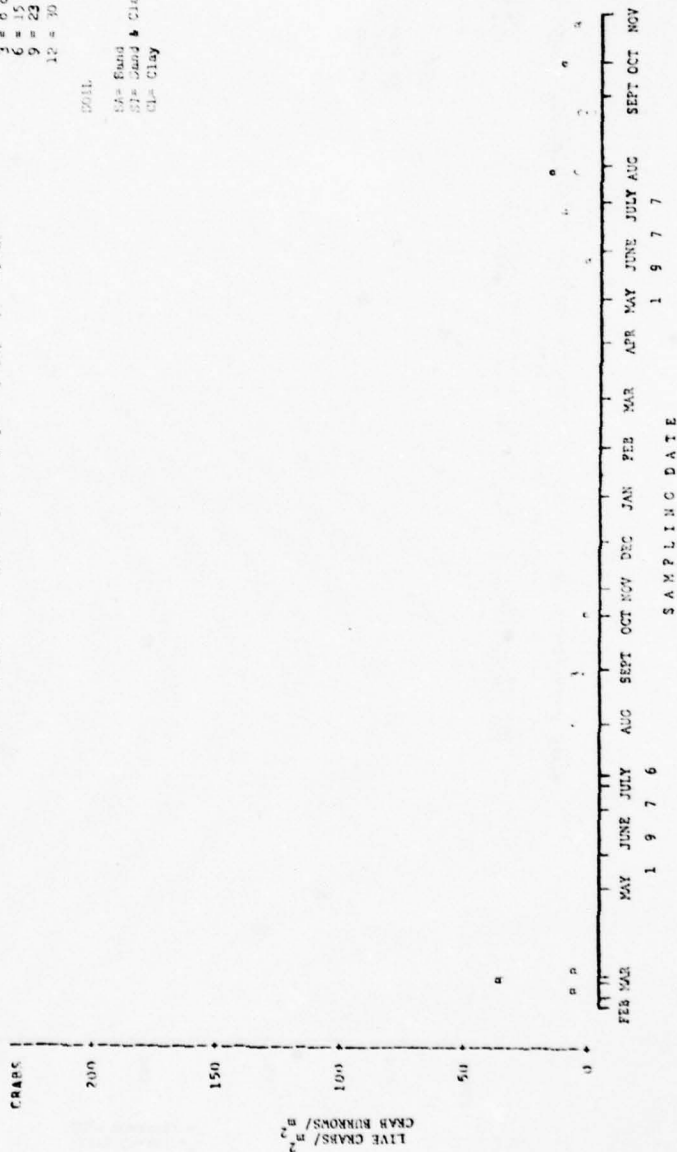
B111

WASH STATE UNIV PLANT EVALUATION AND RECOMMENDATION FOR WASHINGTON  
 HILTON, RICHARD A. JR.  
 JAMES W. MULLIN, JR. OCT 21, 1977

PLANT OF ORIGIN: LINDSEY, SWANSEA, WA  
 PLANT OF ORIGIN: LINDSEY, SWANSEA, WA

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

MOON  
 1st = Band  
 2nd = Band & Clay  
 3rd = Clay  
 4th = Clay  
 5th = Clay  
 6th = Clay  
 7th = Clay  
 8th = Clay  
 9th = Clay  
 10th = Clay  
 11th = Clay  
 12th = Clay

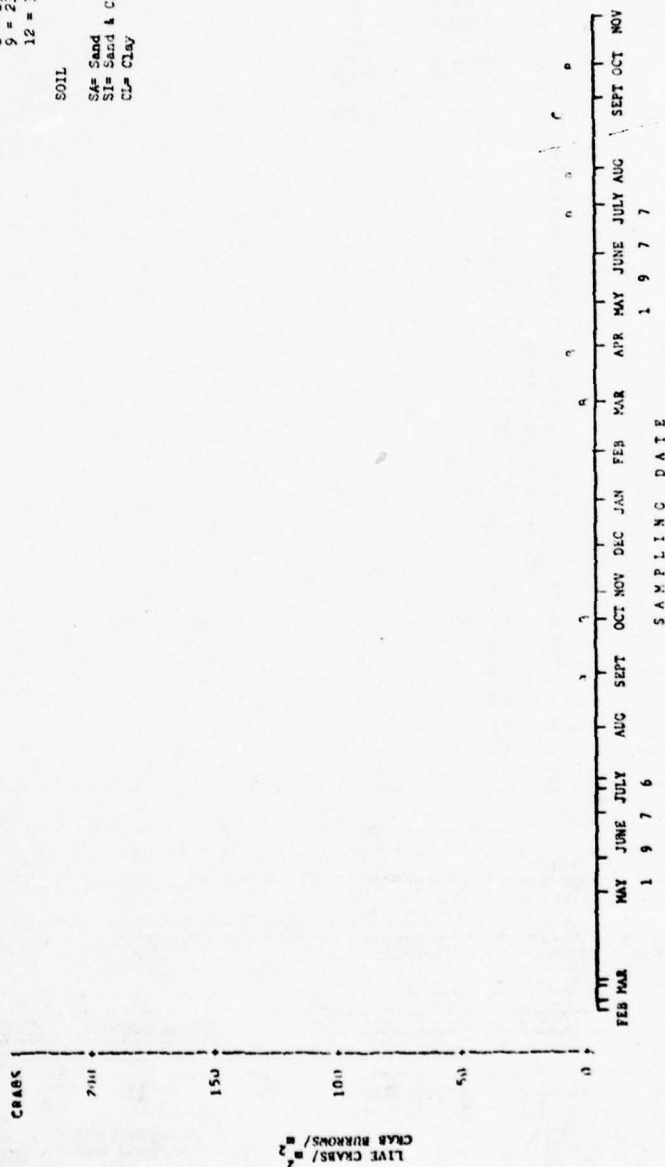


THE UNIVERSITY OF CHICAGO

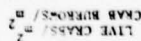
**SPECIFICATION OF THE  
SUBJECTS**

HEIGHT	
3 = 8 cm	24 = 61 cm
6 = 15 cm	36 = 91 cm
9 = 23 cm	
12 = 30 cm	

SOIL MON  
SA= Sand F= February  
SI= Sand & Clay J= July  
CL= Clay O= November



SA= Sand  
CL= Sand & Clay  
CL= Clay

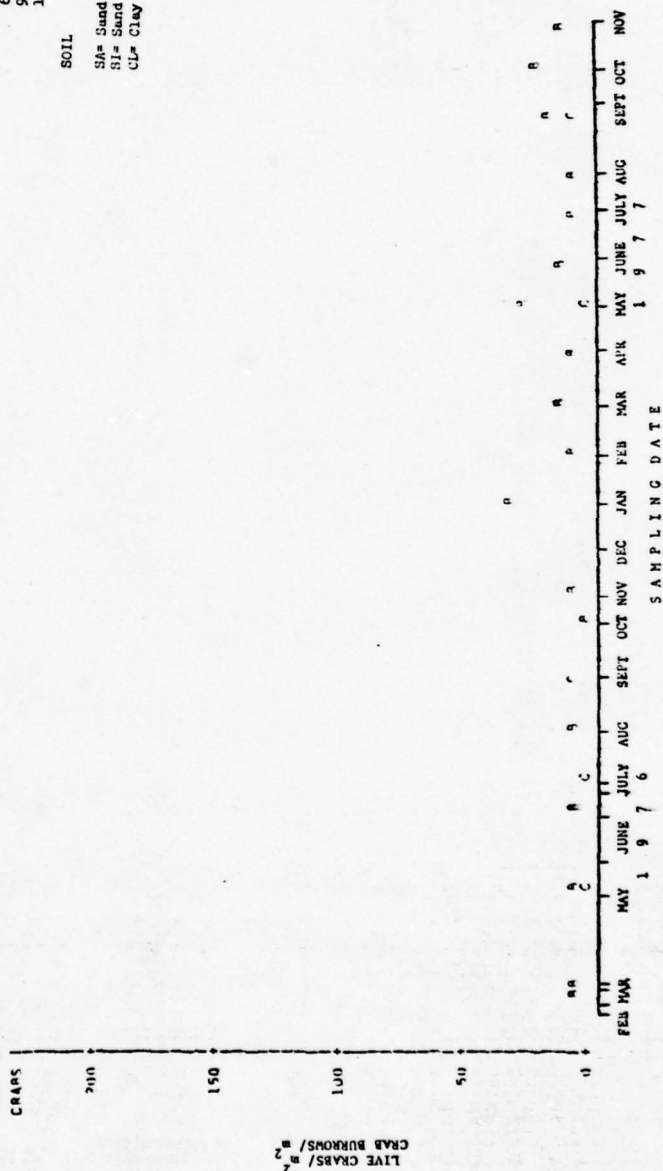


WASP CATCHING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING  
 16:23 W.D.S.V. PROJECT 21, 1977

HEIGHT=12 SOIL=CL MON=6  
 PLOT OF DAY-TRAP LEGEND: SYMBOL USED TO CHARACTERIZE  
 PLOT OF DAY-TRAP LEGEND: SYMBOL USED TO CHARACTERIZE

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL MON  
 SA= Sand P= February  
 SI= Sand & Clay J= July  
 CL= CLAY O= November



B114



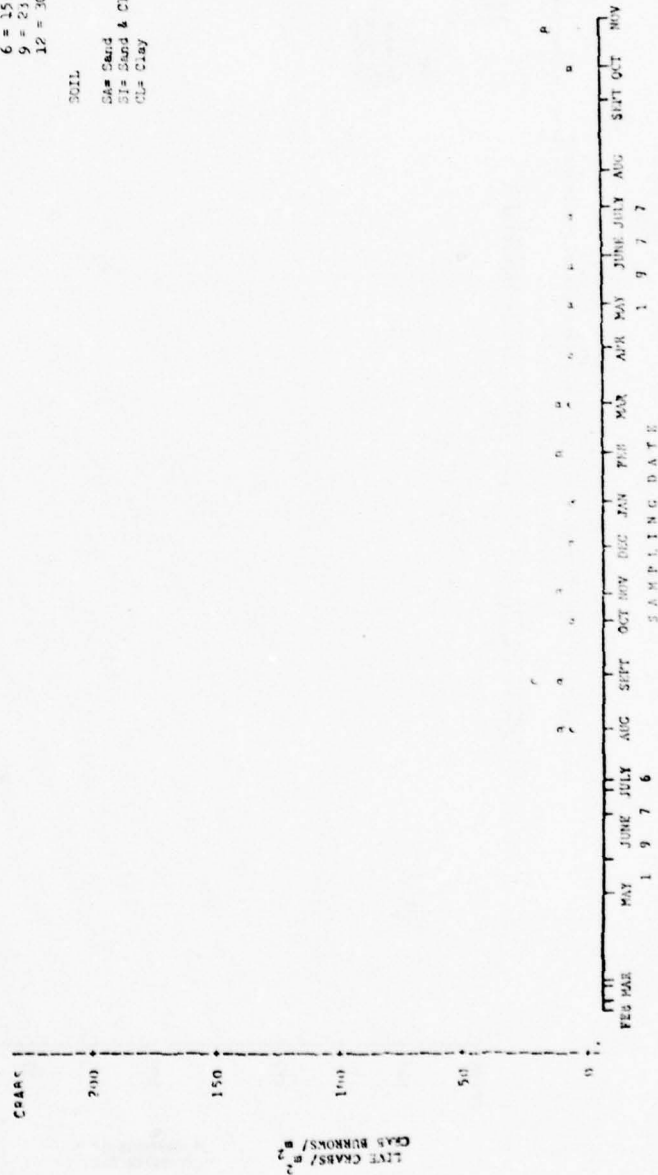
B115

WASH. COUNTY, ID. 1977  
 1. 10m x 12m SOIL (12m x 12m) MCN-1

PLANT: 10m x 12m SOIL (12m x 12m) MCN-1

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL  
 MCN  
 1 = Sand  
 2 = Sand & Clay  
 3 = Clay



WASH STATE DIV OF NAT RESOURCES AND MANAGEMENT, OREGON DIVISION, 21, 1977

PLANT OF DAY CORALS  
 PLANT OF DAY CORALS  
 PLANT OF DAY CORALS

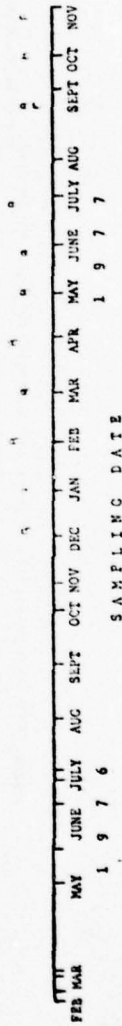
HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL  
 S1 = Sand  
 S2 = Sand & Clay  
 C1 = Clay  
 F = February  
 J = July  
 O = November

CHABRS  
 200  
 150  
 100  
 50  
 0

LIVE CHABRS/  
 CHABR BURROWS/

B116



4761-12 "The Art of the Secret"  
Johannes Vermeer's "The Astronomer"

21-10-12  
21-10-12  
21-10-12

[illegible]

HEIGHT

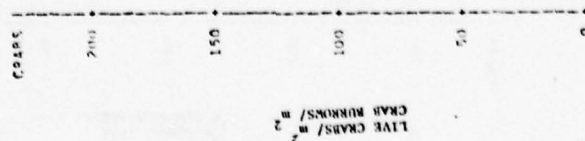
HEIGHT

3=	3 inches	24=	24 inches
6=	6 inches	36=	36 inches
9=	9 inches		
12=	12 inches		



7105

SA= Sand  
SI= Sand & Clay  
CL= Clay  
F= February  
J= July  
O= November

[illegible]

EXAMPLE 1. TVC 04178

Marsh Surveying Plant - Evaluation and Assessment of the Marsh Surveying Plant, December 21, 1977

Height of Plant (cm)

Plot of Average Height of Plant (cm) is indicated by

Legend: Symbol used is indicated by

SOIL MOISTURE

HEIGHT

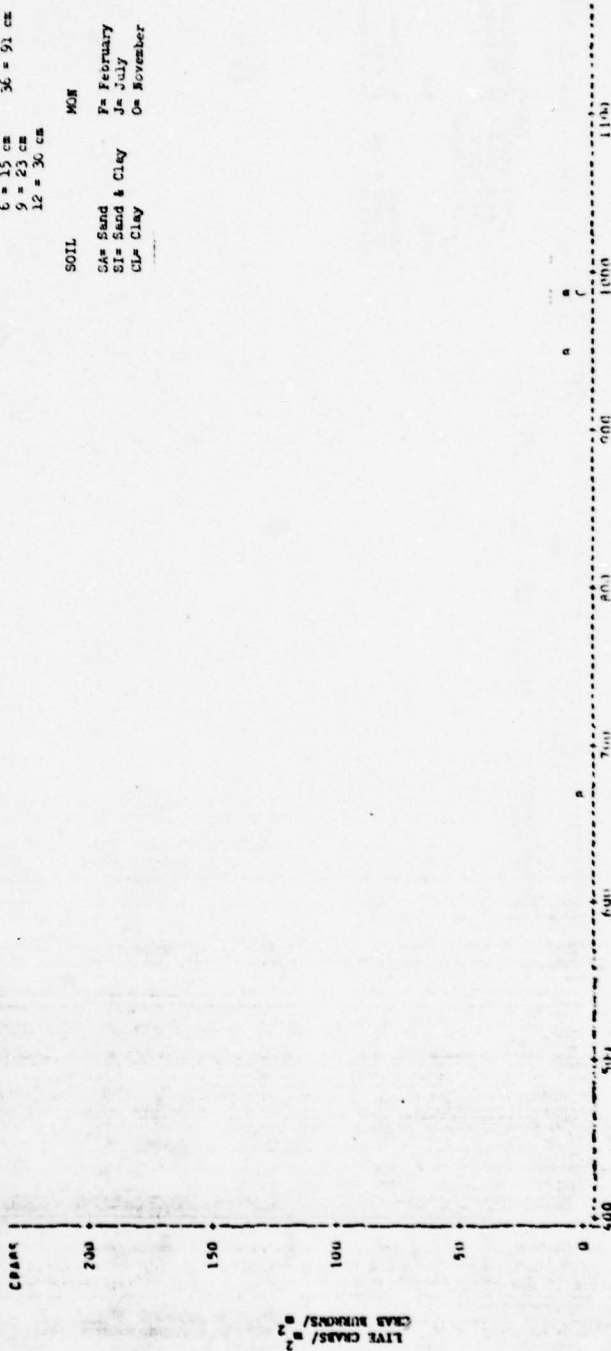
3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

24 = 61 cm  
36 = 91 cm

SOIL MOISTURE

CM = Sand  
SI = Sand & Clay  
CL = Clay

FM = February  
JM = July  
ON = November



B118

B119

WASH. STATE UNIV. COLLEGE OF MARINE STUDIES, PULLMAN, WASH., JULY 21, 1977

STATION: 11-10-10  
 DATE OF SURVEY: 7/21/77  
 NAME OF VESSEL: USCGC 22050

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

MOON  
 1st Quarter  
 2nd Quarter  
 3rd Quarter  
 Full Moon

CRAB

LIVE CRABS/  
 CRAB HOOKS/

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 1 9 7  
 SAMPLING DATE

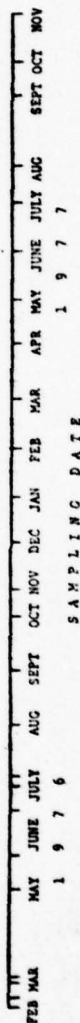
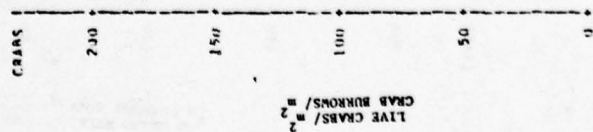


WASCH SYNTHETIC PLANT VALUATION AND NUTRIENT METABOLISM MONITORING 16:23 MEDICAL-S.V. DISC. 11, 1977

PRINCIPAL 12 SOILS: 12 MONS  
 PLOT OF DAY CRABS: LEGEND: SYMBOL USED IS CHARACTERISTIC  
 PLOT OF DAY CRABS: LEGEND: SYMBOL USED IS CHARACTERISTIC

HEIGHT  
 3 = 8 cm 24 = 61 cm  
 6 = 15 cm 36 = 91 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL MON  
 S1 = Sand  
 S2 = Sand & Clay  
 S3 = Clay  
 F = February  
 J = July  
 O = November



B120

WATER SAMPLING PLANT FACILITIES AND MECHANISMS AT WATKINSVILLE, GEORGIA, 1967

PLANT OF DAY: 10:00 AM TO 12:00 PM  
PLANT OF DAY: 12:00 PM TO 2:00 PM

WATER: 10:00 AM TO 12:00 PM  
WATER: 12:00 PM TO 2:00 PM

HEIGHT

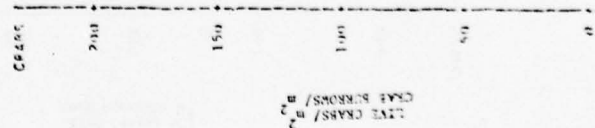
3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

MOON

7 = February  
1 = July  
0 = November

SOIL

0 = Sand  
1 = Sand & Clay  
2 = Clay



FEB	MAR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
		1	9	7	6									1	9	7				

SAMPLING DATE

B122

MARCH SMOTHERING PLANT EVALUATION AND MECHANICAL TREATMENT MONITORING  
 HEIGHT 12 SOILS MONITORING  
 PLANT OF CAVARAS LIGAND CAVARAS USED IS OUTRAGED

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL MON  
 S1 = Sand  
 S1a = Sand & Clay  
 CL = Clay  
 F = February  
 J = July  
 O = November

LIVE CRABS / m<sup>2</sup>  
 CRABS  
 200  
 150  
 100  
 50  
 0

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 SAMPLING DATE



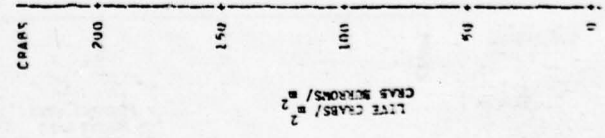
MARSH SOUTHERN PLANT EVALUATION AND MACROINVERTEBRATE MONITORING  
 HEIGHT=24 SPILL=CL MCH=J  
 16th WEDNESDAY, FEBRUARY 21, 1973

PLOT OF CAVESSES LEGEND: SYMBOL USED IS CHARACTER 1  
 PLOT OF CAVESSES LEGEND: SYMBOL USED IS CHARACTER 2

HEIGHT 24 = 61 cm  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

MOH  
 F= February  
 J= July  
 O= November

SOIL  
 SA= Sand  
 SI= Sand & Clay  
 CL= Clay





MASSACHUSETTS PLANT SOCIETY, 100 WASHINGTON STREET, BOSTON, MASS. 02108, SEPTEMBER 21, 1977

PLANT OF DAY: *Asplenium platyneuron* L. (Moss)

HEIGHT: 24 = 61 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

SOIL

2A = Sand  
3B = Sand & Clay  
4C = Clay  
5D = February  
6E = July  
7F = November

LIVE CRABS / m<sup>2</sup>  
CRAB BURROWS / m<sup>2</sup>

SAMPLING DATE

FEB MAR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
	1	9	7	6									1	9	7	7			

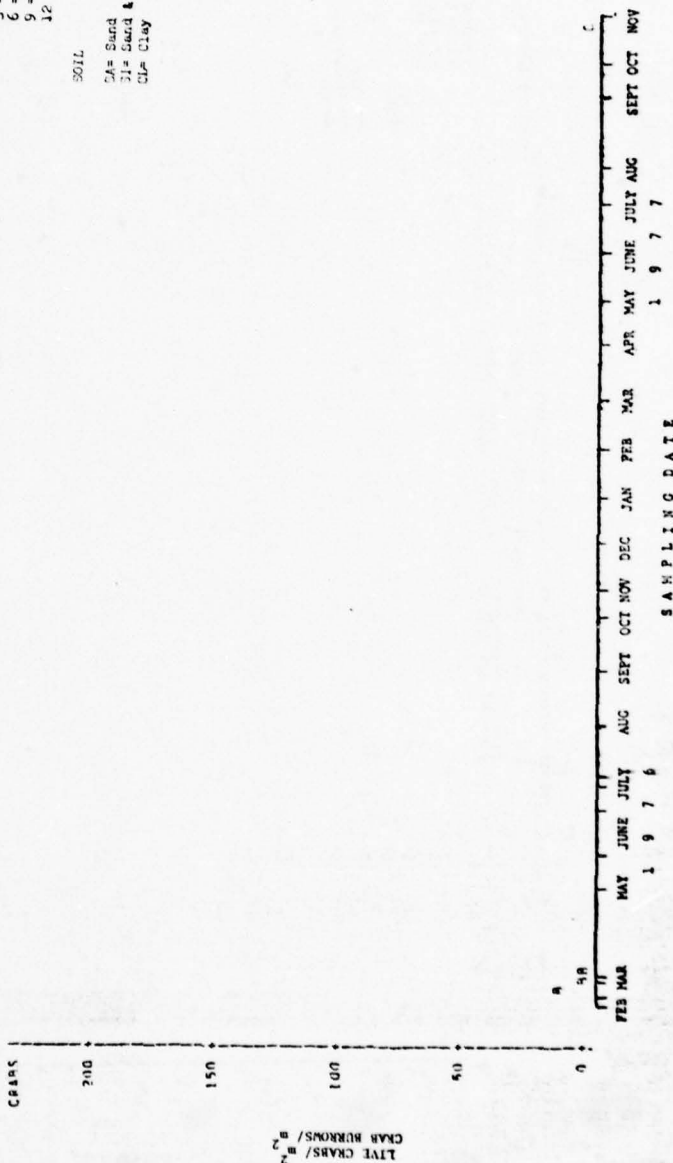
B126

WADSWORTH SWAMPING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING, 1973-1974, DECEMBER 21, 1973

HEIGHT = 24 CM, CRIPPLE WADSWORTH  
 PLANT OF WADSWORTH SWAMPING PLANT USED IN THIS STUDY

HEIGHT 24 = 61 CM  
 6 = 15 CM 30 = 91 CM  
 9 = 23 CM  
 12 = 30 CM

SOIL MCN  
 2A = Sand P = February  
 2B = Sand & Clay J = July  
 2C = Clay O = November



SAMPLING DATE



B128

WASH. STATE UNIV. PLANT EVALUATION AND MACROINVERTEBRATE MONITORING (1473 MEDUSA WAY, SEASIDE, 21, 1977)

HEIGHT: 24 = 61 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

HEIGHT

3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

SOIL

S1 = Sand  
S2 = Sand & Clay  
C1 = Clay

MON

F = February  
J = July  
O = November

CRABS

200

150

100

50

LIVE CRABS/  
CRAB BURROWS/ m<sup>2</sup>

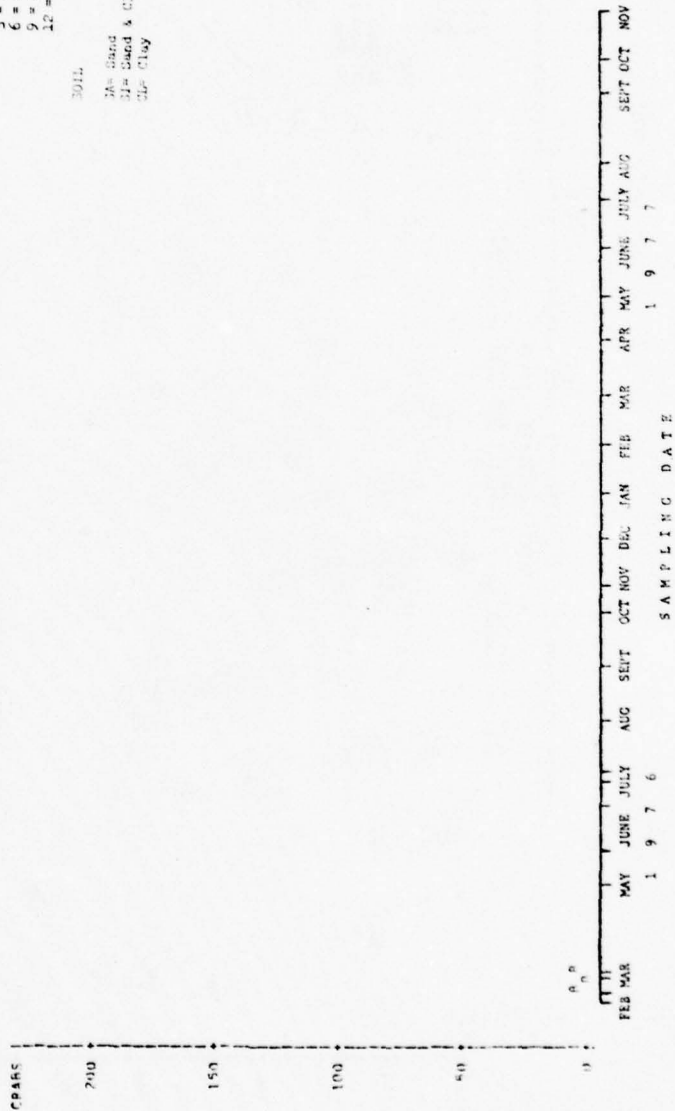
FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
1 9 7 6 1 9 7 7  
SAMPLING DATE

$$Z = 0.06 \quad \Delta S = 7.6 \text{ cal} \quad \gamma_c = 4.0 \times 10^{-4} \text{ cm}$$
[illegible]

HEIGHT	
3 = 8 cm	$\frac{24}{36} = \frac{61}{91}$ cm
6 = 15 cm	
9 = 23 cm	
12 = 30 cm	

NON

3011L  
M= Sand  
M= Sand & Clay  
CL= Clay  
MON  
P= P  
J= J  
C= N





MARSH SWAMPING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING 1977

WEIGHTS: 24, 30, 36, 42, 48, 54, 60, 66, 72, 78, 84, 90, 96, 102, 108, 114, 120, 126, 132, 138, 144, 150, 156, 162, 168, 174, 180, 186, 192, 198, 204, 210, 216, 222, 228, 234, 240, 246, 252, 258, 264, 270, 276, 282, 288, 294, 300, 306, 312, 318, 324, 330, 336, 342, 348, 354, 360, 366, 372, 378, 384, 390, 396, 402, 408, 414, 420, 426, 432, 438, 444, 450, 456, 462, 468, 474, 480, 486, 492, 498, 504, 510, 516, 522, 528, 534, 540, 546, 552, 558, 564, 570, 576, 582, 588, 594, 600, 606, 612, 618, 624, 630, 636, 642, 648, 654, 660, 666, 672, 678, 684, 690, 696, 702, 708, 714, 720, 726, 732, 738, 744, 750, 756, 762, 768, 774, 780, 786, 792, 798, 804, 810, 816, 822, 828, 834, 840, 846, 852, 858, 864, 870, 876, 882, 888, 894, 900, 906, 912, 918, 924, 930, 936, 942, 948, 954, 960, 966, 972, 978, 984, 990, 996, 1000

PLANT OR CHARACTERISTICS LEGEND: SYMBOL USED IS CHARACTERISTICS

PLOT OF CHARACTERISTICS

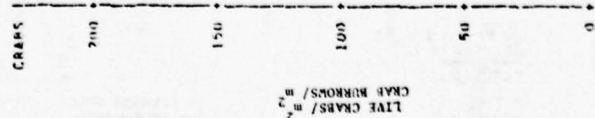
WEIGHTS: 24, 30, 36, 42, 48, 54, 60, 66, 72, 78, 84, 90, 96, 102, 108, 114, 120, 126, 132, 138, 144, 150, 156, 162, 168, 174, 180, 186, 192, 198, 204, 210, 216, 222, 228, 234, 240, 246, 252, 258, 264, 270, 276, 282, 288, 294, 300, 306, 312, 318, 324, 330, 336, 342, 348, 354, 360, 366, 372, 378, 384, 390, 396, 402, 408, 414, 420, 426, 432, 438, 444, 450, 456, 462, 468, 474, 480, 486, 492, 498, 504, 510, 516, 522, 528, 534, 540, 546, 552, 558, 564, 570, 576, 582, 588, 594, 600, 606, 612, 618, 624, 630, 636, 642, 648, 654, 660, 666, 672, 678, 684, 690, 696, 702, 708, 714, 720, 726, 732, 738, 744, 750, 756, 762, 768, 774, 780, 786, 792, 798, 804, 810, 816, 822, 828, 834, 840, 846, 852, 858, 864, 870, 876, 882, 888, 894, 900, 906, 912, 918, 924, 930, 936, 942, 948, 954, 960, 966, 972, 978, 984, 990, 996, 1000

HEIGHT

3 = 0 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

COIL

MCN  
S1 = Sand  
S1 = Sand & Clay  
C1 = Clay  
F = February  
J = July  
O = November



B130

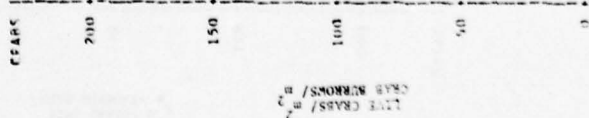
WASH SWOTERING PLANT CULTIVATION AND MACROINVERTEBRATE MONITORING, 1968 WEDNESDAY, DECEMBER 21, 1977

HEIGHT=24 SOIL=21 MHC=0

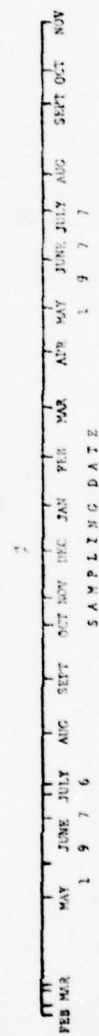
PLOT OF PAVANUS LIGULUS: SWOTER USED 10 CHASSERUS LIGULUS: SWOTER USED 10 CHASSERUS LIGULUS

HEIGHT  
3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

MOON  
1A= Sand  
1B= Sand & Clay  
1C= Clay  
1D= February  
1E= July  
1F= November



LIT CRABS / m²



MASSACHUSETTS PLANT EVALUATION FOR WAREHOUSES, 1974

HEIGHTS, SOILS, MOISTURE

PLANT OF PLANTATIONS, HEIGHTS, SOILS, MOISTURE

HEIGHT  
3 = 8 cm  
6 = 13 cm  
9 = 23 cm  
12 = 30 cm

MOISTURE  
3A = Sand  
3B = Sand & Clay  
3C = Clay

LIVE CRABS / m<sup>2</sup>

SAMPLING DATE

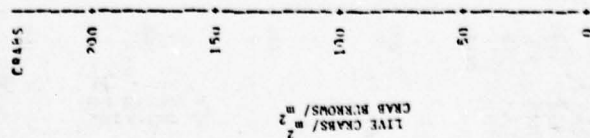
B132



[illegible]

HEIGHT	
3 = 8 CM	24 = 61 CM
6 = 15 CM	36 = 91 CM
9 = 23 CM	
12 = 30 CM	

Soil.		MON
SA = Sand		F = February
SL = Sand & Clay		J = July
CL = Clay		O = November



	FEB	MAR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
SAMPLING DATE			1	9	7	6									1	9	7	7			

B134



B135

LIVE CRABS / m<sup>2</sup>  
CRAB BURROWS / m<sup>2</sup>

WASH SURVEILLING PLANT EVALUATION AND MONITORING STATION, WASHINGTON, D.C. 20540

PLANT OF DAY-CRAB  
PLANT OF DAY-CRAB  
PLANT OF DAY-CRAB

HEIGHT  
3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

SOIL  
S1 = Sand  
S2 = Sand & Clay  
C1 = Clay  
M1 = February  
M2 = July  
C2 = November

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
1 9 7 6 1 9 7 1  
SAMPLING DATE

B136

MASSACHUSETTS PLANT EVOLUTION AND MARCHING OFFICE MONITORING  
 16:23 A-D-SCAY, MICHAEL 21, 1973

HEIGHT: 301-5A MCH-20  
 PLANT OF DAY-GRASS  
 LEGEND: SYMBOL USED IS CHARACTER

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL  
 SA= Sand  
 SI= Sand & Clay  
 CL= Clay  
 MON  
 P= February  
 J= July  
 O= November

CRABS  
 200  
 150  
 100  
 50  
 0

LIVE CRABS/  
 CRAB BURROWS/

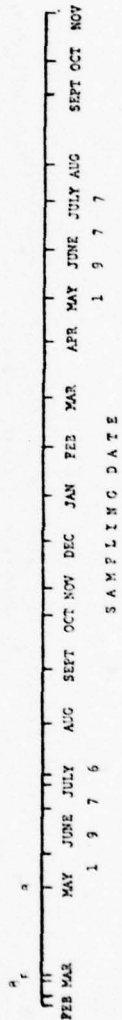
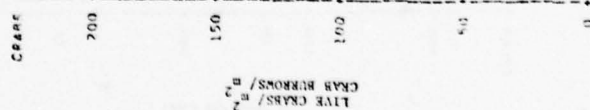
FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 SAMPLING DATE

WASH SURVEILLING PLANT EVALUATION AND MAINTENANCE REPORTS  
 10:23 WILKESBAR, WILKESBAR, 21, 1977

WEIGHTS, SOILS, AND  
 PLANT OR SURVEILLANCE PLANT: SYMBOL USED IN SURVEILLANCE

HEIGHT  
 3 = 8 cm  
 24 = 61 cm  
 6 = 33 cm  
 36 = 91 cm  
 12 = 30 cm

SOIL  
 MCM  
 24 = Sand  
 36 = Sand & Clay  
 12 = Clay  
 24 = February  
 36 = July  
 12 = November



WASH SWOTTESTING PLANT EVALUATION AND MICROINVERTEBRATE MONITORING, 1977  
 HEIGHTS, 5000 FT. (M.S.L.)

PLANT OF DAYCRESS (SUNFLOWER) USED IN MONITORING

HEIGHT

3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

3/4 = 51 cm

3/8 = 31 cm

SOIL

M.S.L.

SA = Sand  
 SL = Sand & Clay  
 CL = Clay  
 FC = February  
 JM = July  
 ON = November

0  
 50  
 100  
 150  
 200  
 250  
 300  
 350  
 400  
 450  
 500  
 550  
 600  
 650  
 700  
 750  
 800  
 850  
 900  
 950  
 1000

LIVE CRABS / M<sup>2</sup>  
 CRAB BURROWS / M<sup>2</sup>

B138

YEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7

SAMPLING DATE

B139

WATERSHED SURVEILLANCE PLANT EVALUATION AND MONITORING PROGRAM, 1977

HEIGHTS, SITES, MONITORING  
 PLANT OF RAY-CECIL SYSTEM USED IS OBSERVED IN  
 PLANT OF RAY-CECIL SYSTEM USED IS OBSERVED IN

HEIGHT  
 3 = 6 cm 24 = 61 cm  
 6 = 15 cm 36 = 91 cm  
 9 = 23 cm  
 12 = 23 cm

MON  
 1A = Sand  
 1B = Sand & Clay  
 1C = Clay  
 1D = February  
 1E = July  
 1F = November

LIVE CRABS / m<sup>2</sup>  
 CRABS  
 200  
 150  
 100  
 50  
 0

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 SAMPLING DATE



MISSISSIPPI PLANT COLLECTION AND MUSEUM, 1000 W. 10th St., 1009

PLANT OF MISSISSIPPI - LEAVES OF SWAMPY WOODS IN MISSISSIPPI

HEIGHT  
 3 = 8 cm  
 6 = 25 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL  
 1st Sand  
 2nd Sand & Clay  
 3rd Clay

LITTER IN

7/1

40

60

80

90

100

110

120

(COYOTE BEAN SNAIL)  
 (MARSH PLEASANT)  
 (LITTORINA LITTORATA)  
 (MELAMPUS BIPUNCTATUS)

B140

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7

SAMPLING DATE

WASH SWAMPING PLANT VALUATION AND RECONSTRUCTION, 1953-1954, December 21, 1954

PLANT OF SWAMPING PLANT VALUATION AND RECONSTRUCTION, 1953-1954, December 21, 1954

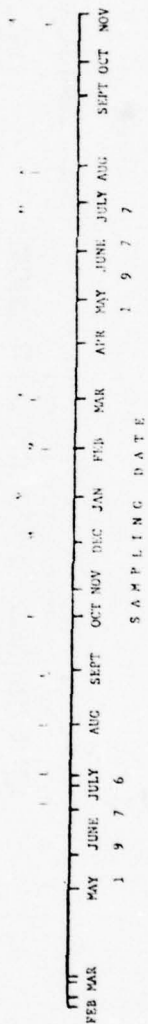
HEIGHT  
3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

SOIL  
5A = Sand  
11 = Sand & Clay  
12 = Clay  
MON  
1 = February  
3 = July  
6 = November

LITTS IN  
70  
60  
50  
40  
30  
20  
10  
0

( MARSH PERIWINKLE )  
LITTORINA IRONATA / m  
( COFFEE BEAN SNAIL )  
HELIX BIDENTATUS / m

B141



WATER CROSSLING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING 10:23 WEDNESDAY, DECEMBER 21, 1977

RESEARCH COLLEGE MONDAY  
 PLOT OF DRYLANDS LEGEND: SYMBOL USED IS CHARACTER A  
 PLOT OF DRYLANDS LEGEND: SYMBOL USED IS CHARACTER A

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm  
 24 = 61 cm  
 36 = 91 cm

MOIL  
 H= Sand  
 S= Sand & Clay  
 CL= Clay  
 F= February  
 J= July  
 O= November

LITRARI  
 70  
 60  
 50  
 40  
 30  
 20  
 10  
 0

(MARSH PERIVOLVILE) 2  
 (COFFEE BEAN SNAIL) 2  
 (LITTONIA IMMOBILIS) 2

B142

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 SAMPLING DATE

B143

( MARSH PERIVIVANTLE )  
 LITTORINA IRRORATA / 2  
 ( COFFEE BEAN SNAIL )  
 MELANOPSIS BIDENTATUS / 2

LITERS IN

70  
60  
50  
40  
30  
20  
10  
0

FEB MAR MAY 1 9 7 6  
 JUN 1 9 7 6  
 JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
 SAMPLING DATE

MARSH SNOWBERRY PLANT EVALUATION AND RECOGNITION MONITORING 1673 WEDNESDAY, DECEMBER 21, 1977

WEIGHTED SOIL-CLAY MOUND  
 PLOT OF DAVENPORT  
 PLOT OF DAVENPORT

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

MOIL  
 14- Sand  
 11- Sand & Clay  
 11- Clay

MOIL  
 14- February  
 11- July  
 11- November

MARSH SNOWBERRY PLANT EVALUATION AND MACHINERY/VEGETATION MONITORING  
10:23 MONDAY, DECEMBER 21, 1977

HEIGHT 301.55 METER  
PLOT OF SNOWBERRY LICHENS: SYMBOL USED IS CHARACTER L  
PLOT OF SNOWBERRY LICHENS: SYMBOL USED IS CHARACTER L

HEIGHT  
3 = 8 cm 24 = 61 cm  
6 = 15 cm 36 = 91 cm  
9 = 23 cm  
12 = 30 cm

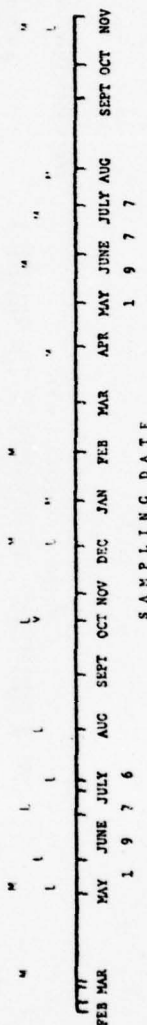
SOIL  
S1 = Sand  
S2 = Sand & Clay  
CL = Clay  
MOB  
F = February  
J = July  
O = November

LITTER

70

(MARSH PERIWINKLE)  
LITTORINA IRONATA / 2  
(COFFEE BEAN SNAIL)  
MELAMPUS BIDENTATUS / 2

B144





MARSH SHOOTING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING 16:23 WEDNESDAY, DECEMBER 21, 1977

HEIGHT = SOIL = 50 MON = 1

PLOT OF PANDANUS LIGNUM 1000 13 CHARACTER 4  
PLOT OF PANDANUS LIGNUM 1000 13 CHARACTER 4

HEIGHT  
3 = 6 cm 24 = 61 cm  
6 = 15 cm 36 = 91 cm  
9 = 23 cm  
12 = 30 cm

SOIL MON  
SA = Sand  
SI = Sand & Clay  
CL = Clay  
P = February  
J = July  
O = November

LITTER IN  
70  
60  
50  
40  
30  
20  
10  
0

( MARSH PERIWINKLE ) 2  
LITTORINA IRROGATA /  
( COFFEE BEAN SNAIL ) 2  
MELAMPUS BIDENTATUS /

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
1 9 7 6 1 9 7 7  
SAMPLING DATE

WASH CROUCHING PLANT ESTABLISHMENT AND MAINTENANCE, DECEMBER 21, 1955

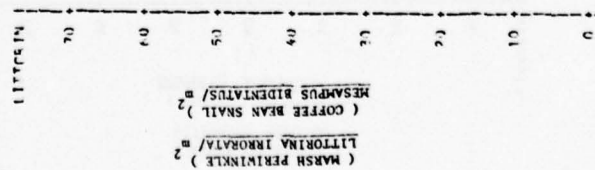
HEIGHT 4000  
 SOIL 4000  
 DRY OF DAYLIGHT  
 DRY OF DAYLIGHT  
 DRY OF DAYLIGHT

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL  
 SA = Sand  
 SI = Sand & Clay  
 CL = Clay

MOON

Fe February  
 Ju July  
 On November



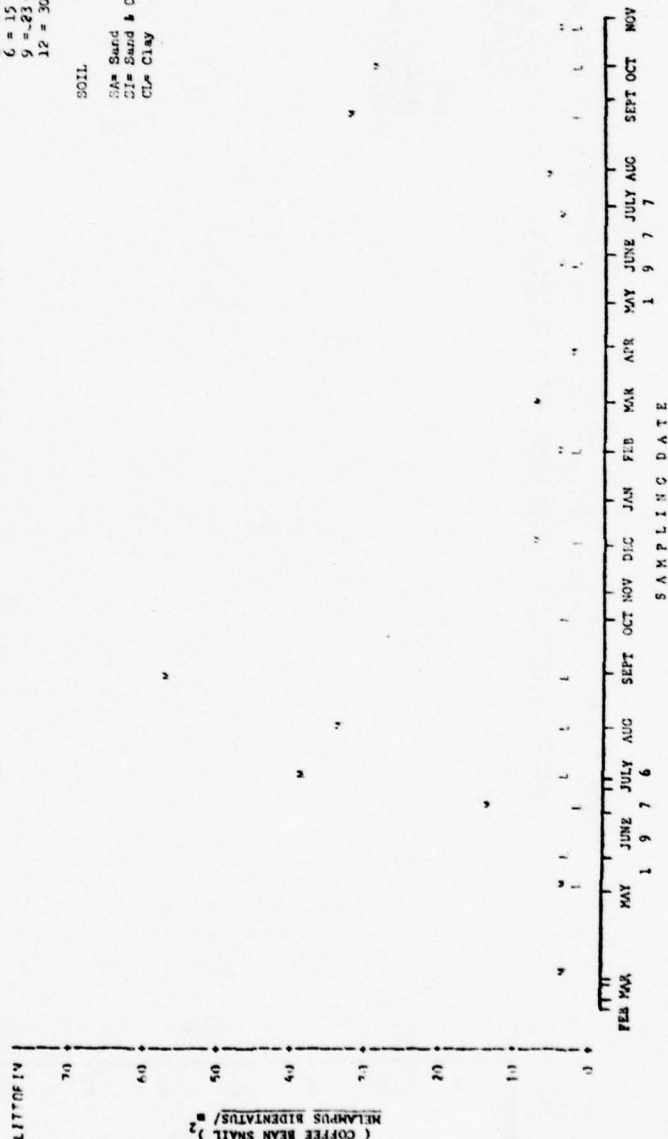
B146

[illegible]

HEIGHT	3 = 6 cm	24 = 61 cm
	6 = 15 cm	36 = 91 cm
	9 = 23 cm	
	12 = 30 cm	

**MON**

SA= Sand  
SI= Sand & Clay  
CL= Clay



WATSH ENTERING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING 15193 W. W. SLAV, December 21, 1977

HEIGHTS: 4000  
PLOT OF DAVALLITONIN 1-27-40: SYMBOL USED IS CHARACTER 4  
PLOT OF DAVALLITONIN 1-27-40: SYMBOL USED IS CHARACTER 4

HEIGHT  
3 = 8 cm 24 = 61 cm  
6 = 15 cm 36 = 91 cm  
9 = 23 cm  
12 = 30 cm

SOIL MON  
S1 = Sand  
S2 = Sand & Clay  
C1 = Clay  
F = February  
J = July  
O = November

LITTE IN

70

60

50

40

30

20

10

0

( MARSH PERINIKLE )  
LITTONINA INKORATA / 2  
( COFFEE BEAN SNAIL )  
MELAMPUS BIDENIATIS / 2

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
1 9 7 6 1 9 7 7

SAMPLING DATE

WADSWORTH COUNTY PLANT SOCIETY AND WADSWORTH COUNTY MUSEUM 16123 WADSWORTH, CALIFORNIA 21, 1977

PLANT OF WADSWORTH COUNTY MUSEUM 16123 WADSWORTH, CALIFORNIA 21, 1977

HEIGHT

2 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

SOIL

2A = Sand  
11 = Sand & Clay  
12 = Clay

MOON

Fe February  
Ja July  
Oc November

0  
10  
20  
30  
40  
50  
60  
70  
80  
90  
100

( MARSH PERIWINKLE )  
LITTORINA IRROGATA / #2  
( COFFEE BEAN SNAIL )  
MELANOPSIS BIDENTATUS / #2

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV

SAMPLING DATE

1 9 7 7

1 9 7 6



4601-12 47th St, Brooklyn, NY 11219  
611 212-224-2244

1000  
 900  
 800  
 700  
 600  
 500  
 400  
 300  
 200  
 100  
 0

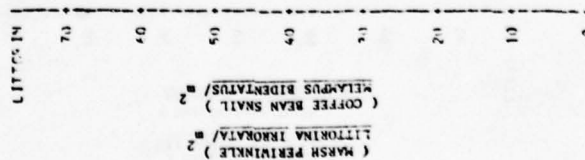
HEIGHT	
3 = 8 cm	24 = 61 cm
6 = 15 cm	36 = 91 cm
9 = 23 cm	
12 = 30 cm	

SOIL                      MCN

SA= Sand                      P= February

SI= Sand & Clay              J= July

CL= Clay                      O= November



SAMPLING DATE	
FEB MAR	1 9 7 6
MAY JUNE JULY	1 9 7 6
AUG SEPT	
OCT NOV	
DEC JAN	
FEB MAR	
APR MAY	1 9 7 7
JUNE JULY	
AUG SEPT	
OCT NOV	

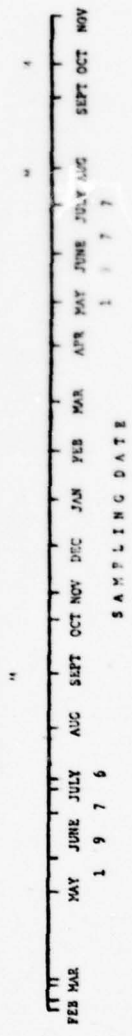
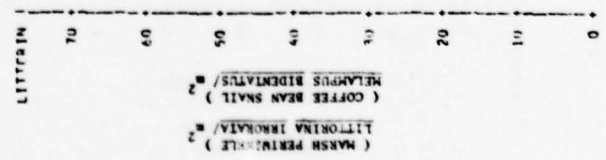
**B150**

MARSH SMOTHERING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING INC. 16:33 WEDNESDAY, 7 DECEMBER 21, 1977

HEIGHTS SOILS MON-J  
 PLOT OF DAY-LITTER IN LEGEND: SYMBOL USED IS CHARACTER 4  
 PLOT OF DAY-LITTER IN LEGEND: SYMBOL USED IS CHARACTER 4

HEIGHT  
 3 = 6 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL MON  
 S1= Sand  
 S2= Sand & Clay  
 CL= Clay  
 F= February  
 J= July  
 O= November





B153

LITTORIN  
 70  
 60  
 50  
 40  
 30  
 20  
 10  
 0

( MARSH PERIWINKLE )  
 LITTORINA IRONATA / 2  
 ( COFFEE BEAN SNAIL )  
 MELANOPUS BIDENTATUS / 2

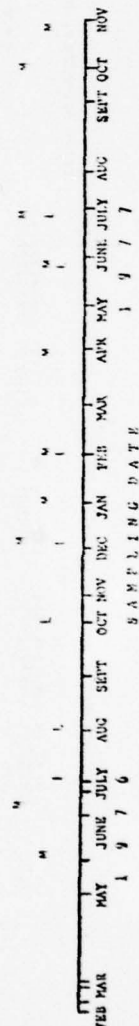
MARSH SPREADING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING  
 122  
 10:23 WEDNESDAY, DECEMBER 21, 1977

HEIGHT = 24 = 61 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 23 cm

SOIL MON  
 SA = Sand  
 SI = Sand & Clay  
 CL = Clay

HEIGHT  
 24 = 61 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 23 cm

LEGEND: SYMBOL USED IS CHARACTERISTIC  
 OF DAY-LITTORINUS  
 OF DAY-LITTORINUS



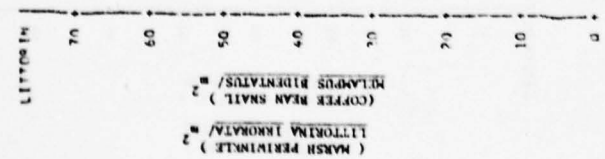
WATER SAMPLING PLANT EVALUATION AND WATER QUALITY MONITORING 16:23 WEDNESDAY, SEPTEMBER 21, 1977

HEIGHTS: 50' 10" WIND: 10

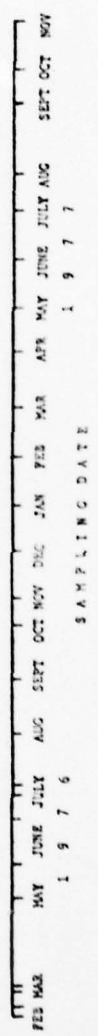
PLANT OF ORIGIN: 100% (100% WIND) 100% (100% WIND) 100% (100% WIND)

REPORT  
 3 = 8 cm  
 6 = 23 cm  
 12 = 30 cm  
 30 = 51 cm

SOIL: MCK  
 GA= Sand  
 SL= Sand & Clay  
 CL= Clay  
 F= February  
 J= July  
 O= November



(LITTON IN INK) /  
 (LITTON IN INK) /  
 (LITTON IN INK) /



SAMPLING DATE



MARSH SNOUTWEAVING PLANT EVALUATION AND WACOMINVESTMENTAL ANALYSIS HAS 124  
 10000 WACOMINVESTMENTAL ANALYSIS HAS 21, 1977

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

HEIGHT

24 = 61 cm  
 30 = 91 cm

SOIL

SA = Sand  
 SH = Sand & Clay  
 CL = Clay

MOON

F = February  
 J = July  
 O = November

LITTORIN  
 70  
 60  
 50  
 40  
 30  
 20  
 10  
 0

( MARSH PERIWINKLE )  
 LITTORINA IMMOBILIS / m  
 2  
 ( COFFEE BEAN SNAIL )  
 MELAMPUS BIDENTATUS / m  
 2

B155

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 SAMPLING DATE

WASH STATE PLANT EVALUATION AND MACROINVERTEBRATE MONITORING  
 1977 MONDAY, DECEMBER 21, 1977

HEIGHT: 20 cm  
 30 cm  
 60 cm  
 90 cm  
 120 cm

HEIGHT  
 20 = 61 cm  
 30 = 91 cm  
 60 = 15 cm  
 90 = 23 cm  
 120 = 30 cm

SOIL  
 S1 = Sand  
 S2 = Sand & Clay  
 C1 = Clay  
 M2 = February  
 J2 = July  
 O2 = November

LEGEND: SYMBOL USED IS CHARACTER &  
 LEGEND: SYMBOL USED IS CHARACTER &

LITERS IN

( MARSH PERIWINKLE )  
 LITTORINA LITTORATA / 2  
 ( COFFEE BEAN SNAIL )  
 MELAMPUS BIDENTATUS / 2

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 SAMPLING DATE

MAASH SOWERING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING  
10120 W. 28th St., P.O. Box 214, 1977  
126

$$f = 0.27 \quad 15 = 1.05 \quad \gamma = 1.051 - 4$$
[illegible]

3 = 8 cm	HEIGHT	24 = 61 cm
6 = 15 cm		36 = 91 cm
9 = 23 cm		
12 = 30 cm		

SOIL

SA= Sand  
SI= Sand & Clay  
CL= Clay  
F= February  
J= July  
O= November

SA= Sand  
SI= sand & clay  
CL= Clay

61-1117

70

60

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40

Co

20

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0

( MARSH PERIWINKLE )  
LITTORINA IRROKATA/ = 2

( COFFEE BEAN SNAIL )  
MESAMPUS BIDENTATUS / 2

B157 \

[illegible]

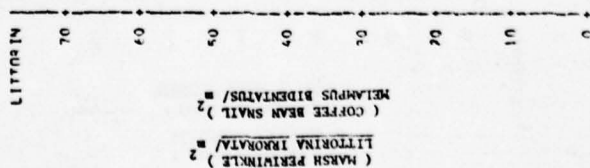
MARSH SWAMPING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING  
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MARSH SNOWBERRY PLANT EVALUATION AND MACROINVERTEBRATE MONITORING  
10221 WILSON AVENUE, DECEMBER 21, 1977

HEIGHT MONITOR  
PLOT OF DAYLIGHT PLANT  
PLOT OF DAYLIGHT PLANT

HEIGHT  
3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm  
24 = 61 cm  
36 = 91 cm

SOIL  
S1 = Sand  
S2 = Sand & Clay  
CL = Clay  
MOR  
F = February  
J = July  
O = November



( MARSH PERIWINKLE )  
LITTORINA IMBRICATA / 2  
( COFFEE BEAN SNAIL )  
MELAMPUS NIDENSATUS / 2

B159



B160

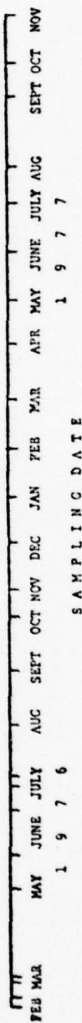
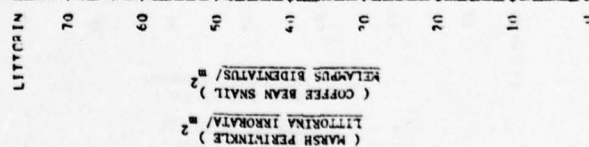
WASH SWATHING AND EVALUATION AND MARSHING AND MARSHING MONITORING 16:00 WEDNESDAY, SEPTEMBER 21, 1977

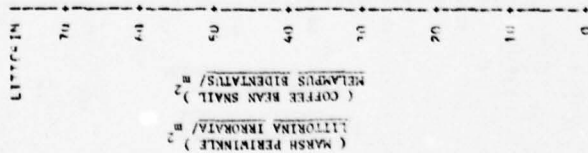
HEIGHTS 100-101 100-101  
 PLOT OF DAY-LEVELING (PLOT OF SWATH) 100-101 100-101

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL

SM= Sand  
 CL= Sand & Clay  
 CF= Clay  
 F= February  
 J= July  
 O= November



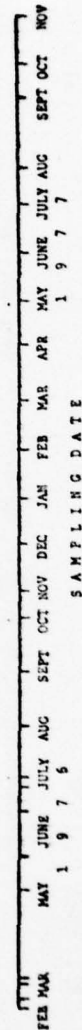


WASH. STATE COLLEGE PLANT EVALUATION AND MARSH PERIWINKLE MONITORING DATA, 1977

PLANT OF DAY: LITorea sp. USED IN CHARTER 1  
PLANT OF DAY: LITorea sp. USED IN CHARTER 2

HEIGHT  
3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm  
24 = 61 cm  
36 = 91 cm

SOIL  
S1 = Sand  
S2 = Sand & Clay  
C1 = Clay  
MCN  
Y = February  
J = July  
O = November



SAMPLING DATE

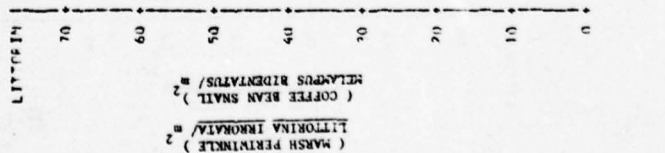
B162

MARSH SNOUTNEPPING PLANT EVALUATION AND MARSHING EXAMINATE MONITORING 16222 WEDNESDAY, SEPTEMBER 21, 1977

PLANT OF NAVY/STATION 16222: SWAMP USED TO CHARACTERIZE A  
PLOT OF NAVY/STATION 16222: SWAMP USED TO CHARACTERIZE A

HEIGHT  
3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm  
24 = 61 cm  
36 = 91 cm

SOIL  
MON  
S1 = Sand  
S2 = Sand & Clay  
C1 = Clay  
F = February  
J = July  
O = November

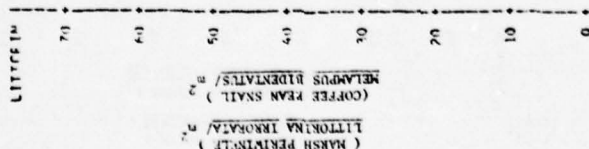


WASH STATE PLANT EVALUATION AND MACHINE RESEARCH INC. 1200 W. 12TH, TACOMA, WASH. 98401

PLOT OF MAY-1977  
PLOT OF MAY-1977  
PLOT OF MAY-1977

HEIGHT  
3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

MOB  
S1 = Sand  
S2 = Sand & Clay  
CL = Clay  
F = February  
J = July  
O = November



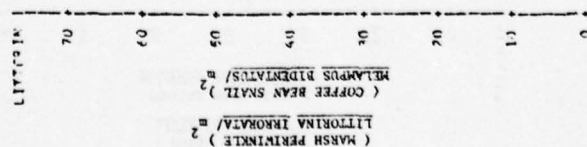
MADRID SWITZERLAND THE VALLEY OF THE MOUNTAINS  
1973 SEPTEMBER 21, 1973

[illegible]

HEIGHT	
3 = 8 cm	24 = 61 cm
6 = 13 cm	36 = 91 cm
9 = 23 cm	
12 = 30 cm	

MON  
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SA= Sand  
SI= Sand & Clay  
CL= Clay



		SAMPLING DATE																				
		FEB	MAR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
				1	9	7	6										1	9	7	7		

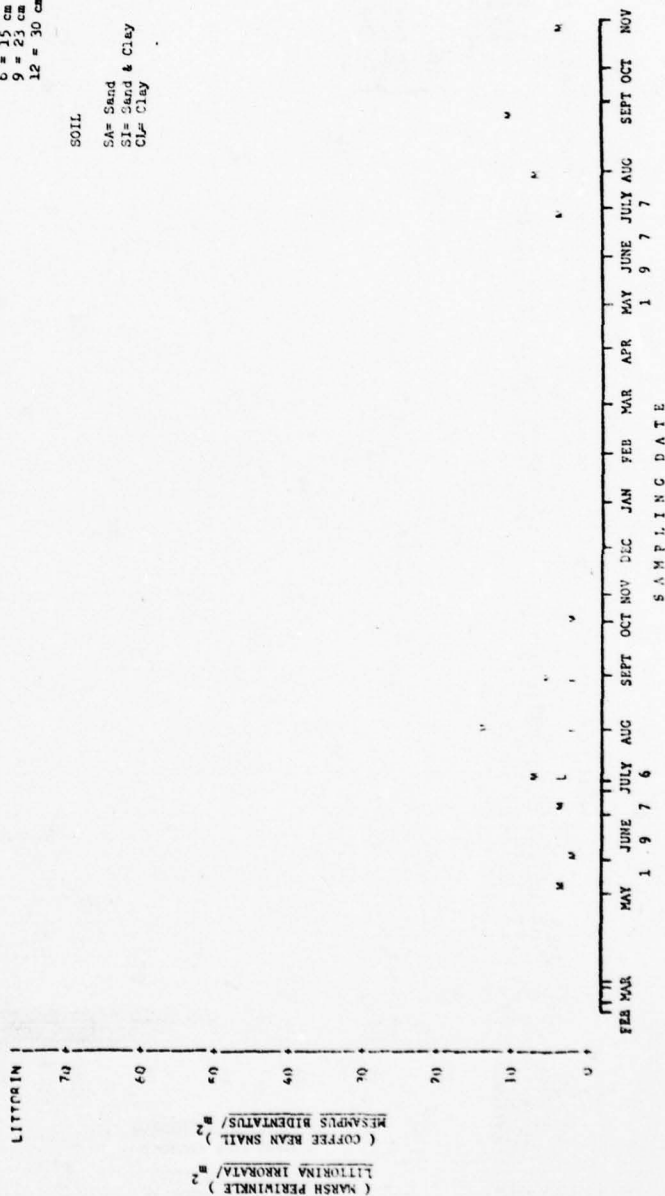
SAMPLE INCDATE



$$= 2.06 \times 10^{-10} \text{ s} = 20.6 \text{ ns}$$

3	= 8 cm	HEIGHT	24	= 61 cm
6	= 15 cm		36	= 91 cm
9	= 23 cm			
12	= 30 cm			

SOIL MON  
SA= Sand F= February  
SI= Sand & Clay J= July  
CL= Clay O= November



B166

WASH STATE PLANT CULTIVATION AND WASH STATE INVERNESS WASH STATE 1977

WASH STATE PLANT CULTIVATION AND WASH STATE INVERNESS WASH STATE 1977

WASH STATE PLANT CULTIVATION AND WASH STATE INVERNESS WASH STATE 1977

HEIGHT  
3 = 0 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

SOIL  
M1 = Sand  
M2 = Sand & Clay  
M3 = Clay  
M4 = February  
M5 = July  
M6 = November

LITIGATION

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(MASH PERIMINIA)  
(CORREX BEAN SNAIL)  
(MASH PERIMINIA)  
(CORREX BEAN SNAIL)

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV

SAMPLING DATE

1 9 7 7

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MARSH SMOTHERING PLANT - ALL PLANTS AND MARSH PLANTS ARE DEAD - 1977

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

24 = 61 cm  
 36 = 91 cm

SOIL  
 SM = Sand  
 SI = Sand & Clay  
 CL = Clay  
 MCN  
 F = February  
 J = July  
 O = November

LIT-OR IN

( MARSH PERIWINKLE )  
 LITTORINA IRROGATA / 2  
 ( COFFEE BEAN SNAIL )  
 MELAMPUS BIDENTATUS / 2

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
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 SAMPLING DATE

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GEORGIA UNIV BRUNSWICK MARINE EXTENSION SERVICE

F/G 13/2

THE EFFECTS OF SMOTHERING A 'SPARTINA ALTERNIFLORA' SALT MARSH --ETC(U)

JUL 78 R J REIMOLD, M A HARDISKY, P C ADAMS

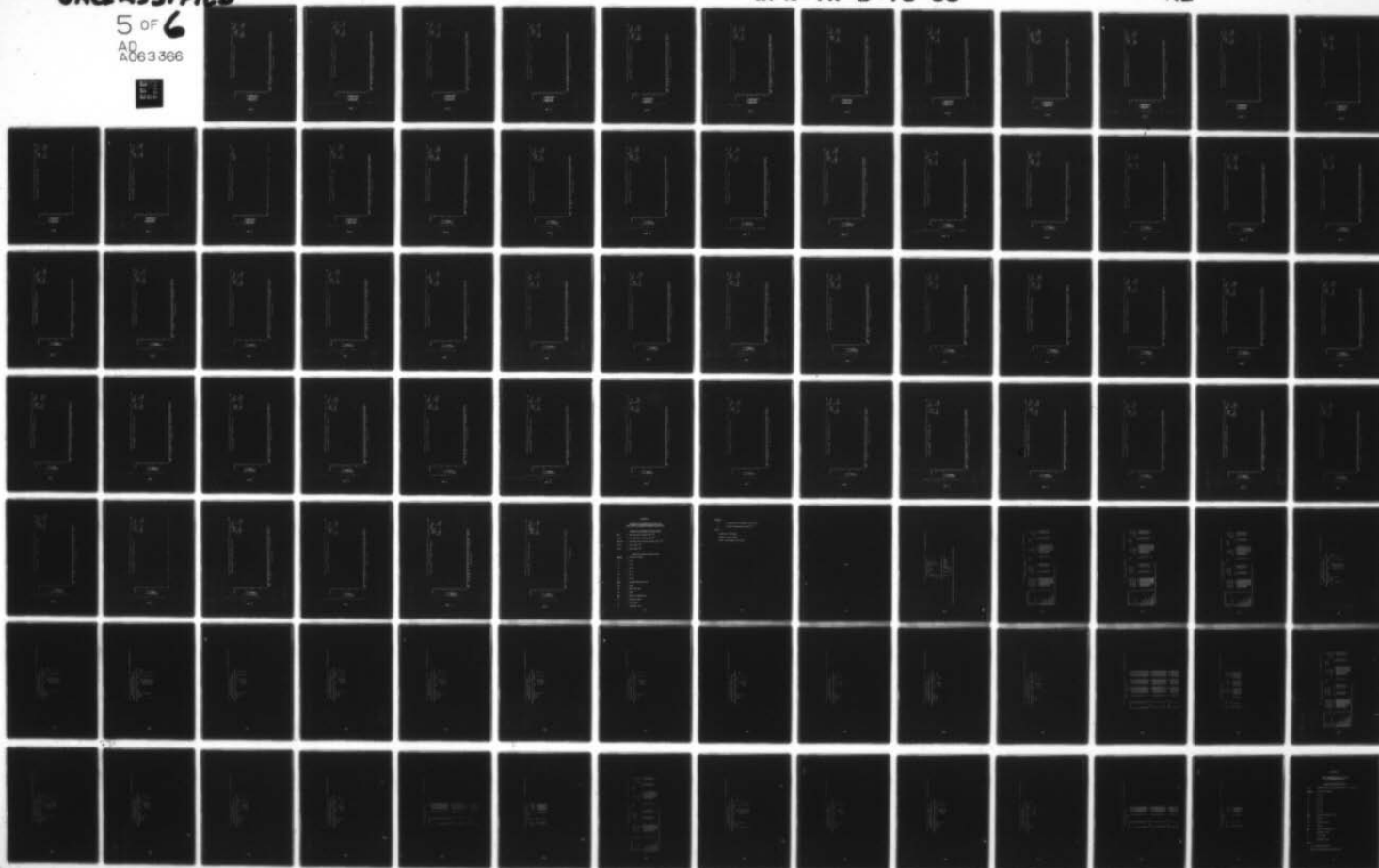
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5 OF 6  
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MADEH ENVIRONMENTAL PLANT EVALUATION, AND MACROINVERTEBRATE MONITORING, 1973-1977, U.S.G.F. 21, 1977

WATERWAY COLLECTOR

PILOT OF DAY-LIT-ASIN (LEGEND: SNAIL, H.C. TO CHARTERED)

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL  
 SA = Sand  
 SI = Sand & Clay  
 CL = Clay

MOON  
 F = February  
 J = July  
 O = November

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(MARSH PERIWINKLE)  
 LITTORINA IRROGATA  
 (COFFEE BEAN SNAIL)  
 MELANOPSIS BIDENTATUS

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV

SAMPLING DATE

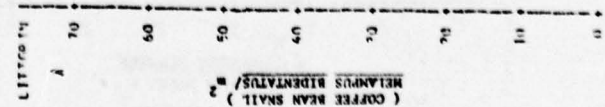
WATER SAMPLING PLANT DATA IN AND NEAR CANNONVILLE, UTAH, 1977

PLANT DATA: PLANT DATA IN AND NEAR CANNONVILLE, UTAH, 1977

HEIGHT  
3 = 8 cm  
6 = 15 cm  
9 = 22 cm  
12 = 30 cm

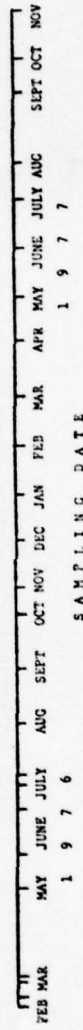
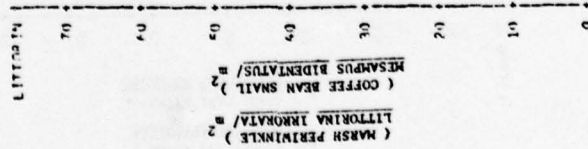
SOIL  
S1 = Sand  
S2 = Sand & Clay  
CL = Clay

( MARSH PERIWINKLE )  
( COFFEE BEAN SNAIL )  
( MELANOPSIS BIDENTATUS )



SAMPLING DATE  
FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV

B170



WASH. STATE UNIV. PLANT CULTIVATION AND PROPAGATION DIVISION, PULLMAN, WASH. 99163, 21, 1977

PLANT: *LITTORINA IRRONATA* (MARSH PERIWINKLE)

HEIGHT:

3 = 8 cm	24 = 61 cm
6 = 15 cm	36 = 91 cm
9 = 23 cm	
12 = 30 cm	

SOIL:

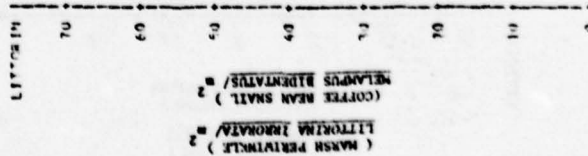
SA = Sand	MCN
SH = Shale	Fe February
CL = Clay	Ja July
	On November

4401 117 470000 147 57 400 6000  
071 001 117 470000 147 57 400 6000

1997-1998 *Journal of the American Medical Association*

3 = 6 cm	HEIGHT	24 = 61 cm
6 = 15 cm		36 = 91 cm
9 = 23 cm		
12 = 30 cm		

SOIL	WSE
SA= Sand	F= February
SI= Sand & Clay	J= July
CL= Clay	O= November



	FEB	MAR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
SAMPLE DATE			1976												1977							

SAMPLING DATE



B172

LITTORIN  
70  
60  
50  
40  
30  
20  
10  
0

( MARSH PERIWINKLE )  
LITTORINA IRONICATA  
2

( COFFEE BEAN SNAIL )  
HELICOPUS RIDENTATUS  
2

WASH STATE UNIV PLANT TALL WITH TWO MAGNOLIA-TYPE BRANCHES (1970) WEDNESDAY, JULY 21, 1971

PLANT OF DAVALLIUM (1970) WHICH WAS 15 CM IN HEIGHT & 12 CM IN DIAMETER

HEIGHT  
3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

SOIL  
SA = Sand  
SI = Sand & Clay  
CL = Clay

MOON  
F = February  
J = July  
O = November

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV

1 9 7 6 1 9 7 7

SAMPLING DATE





WAPSH SMOTHERING PLANT INVESTIGATION AND RECOLLECTOR'S MONITORING  
 1973 MARCH 21, 1977

HEIGHT 12 COLLUMS 12  
 1200-1200 DAY 1200-1200  
 1200-1200 DAY 1200-1200

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL  
 SA = Sand  
 SI = Sand & Clay  
 CL = Clay

MOON

1 = February  
 2 = July  
 3 = November

LITTON IN  
 70  
 60  
 50  
 40  
 30  
 20  
 10  
 0

(COFFEE BEAN SNAIL) 2  
 (MARSH PERIWINKLE) 2  
 (LITTORINA IRONICATA) 2  
 (MELAMPUS BIDENTATUS) 2

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7

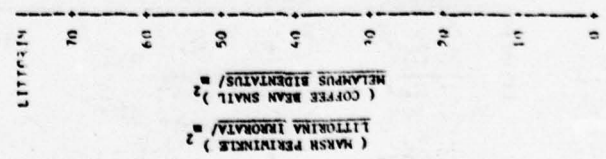
SAMPLING DATE

MARSH ENCLOSURE PLANT EVALUATION AND RECONSTRUCTION ADMINISTRATION  
 1977

HEIGHTS  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL  
 S1 = Sand  
 S2 = Sand & Clay  
 C1 = Clay

PLANT OF ENCLOSURE  
 1. COFFEE SNAIL (MELANOPSIS BIDENTATUS)  
 2. MARSH PERIWINKLE (LITTORINA LITTORATA)



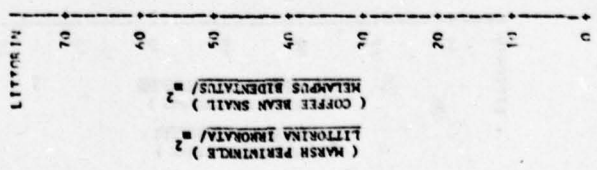
B175

MARSH SURVEYING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING  
 LOSS W. J. JONES, December 21, 1977

HEIGHT 12' 0" (12' 0" = 12' 0")  
 PLOT OF DISTANCE 12' 0" (12' 0" = 12' 0")  
 PLOT OF DISTANCE 12' 0" (12' 0" = 12' 0")

HEIGHT  
 3 = 8 cm  
 6 = 24 cm  
 9 = 36 cm  
 12 = 91 cm

SOIL  
 S1 = Sand  
 S2 = Sand & Clay  
 S3 = Clay  
 F = February  
 J = July  
 O = November



B176

SAMPLING DATE  
 FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7



MARSH ENGINEERING PLANT EVALUATION AND WATER IMMOBILIZATION STUDY, 1977

1623 KATHLEEN AV, P.O. BOX 21, 1977  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOILS: SAND, SILT, CLAY  
 SOILS: SAND, SILT, CLAY  
 SOILS: SAND, SILT, CLAY

LITTER IN  
 70  
 60  
 50  
 40  
 30  
 20  
 10  
 0

( MARSH PERIWINKLE )  
 ( COFFEE BEAN SNAIL )  
 ( LITTORINA IRROGATA )

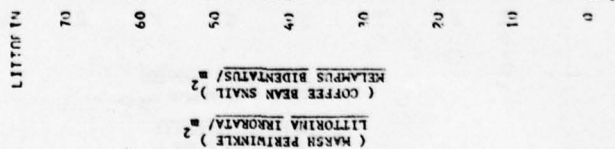
B177

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 SAMPLING DATE





B179



( MARSH PERIWINKLE )  
LITTORINA LITTOREA / 2  
( COFFEE BEAN SNAIL )  
LITTORINA LITTOREA / 2

MASSACHUSETTS PLANT EVALUATION FOR MARSH RESTORATION PROJECTS, 1978-1979

DATE OF PLANTING: 1978-1979

HEIGHT

3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

SOIL

S1 = Sand  
S2 = Sand & Clay  
C1 = Clay

MOB

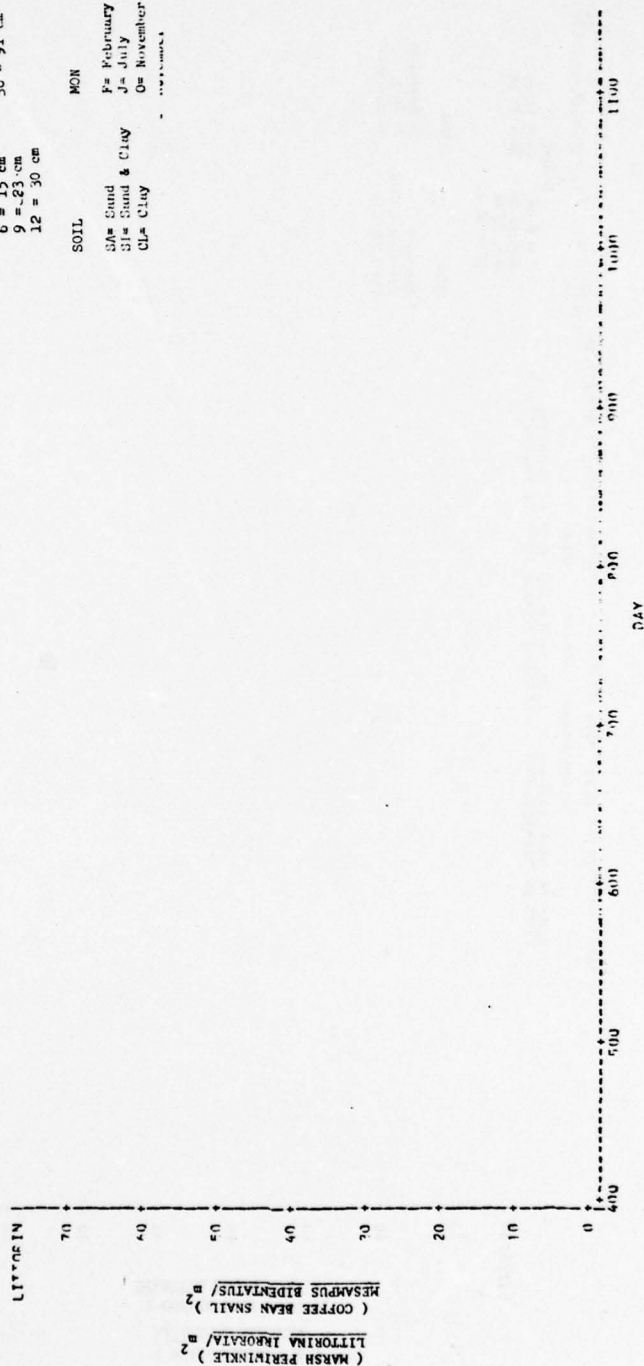
F = February  
J = July  
O = November

MACROB SUBSTITUTION PLANT EVALUATION AND MACROINVERTEBRATE MONITORING  
16:23 MEDNESDAY, DECEMBER 21, 1977  
149

$\mu = 0.06$ ,  $\sigma^2 = 1.19$ ,  $\rho = -0.74$

HEIGHT	
3 = 8 cm	24 = 61 cm
6 = 15 cm	36 = 91 cm
9 = 23 cm	
12 = 30 cm	

SOIL MON  
SA= Sand F= February  
SI= Sand & Clay J= July  
CL= Clay O= November

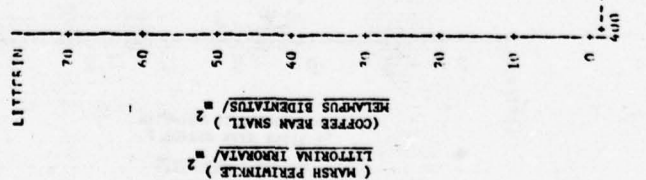


MARSH SODIUM PLANT EVALUATION AND MACROINVERTEBRATE MONITORING  
 JASON HUNTER, Chicago 21, 1977

HEIGHT 24  
 SOILS 4000  
 PLOT OF DAY-LEVELING  
 PLOT OF DAY-LEVELING

HEIGHT  
 24 = 61 cm  
 36 = 51 cm  
 3 = 6 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL  
 SA= Sand  
 SI= Sand & Clay  
 CL= Clay  
 MOX  
 Fe= February  
 Ju= July  
 O= November



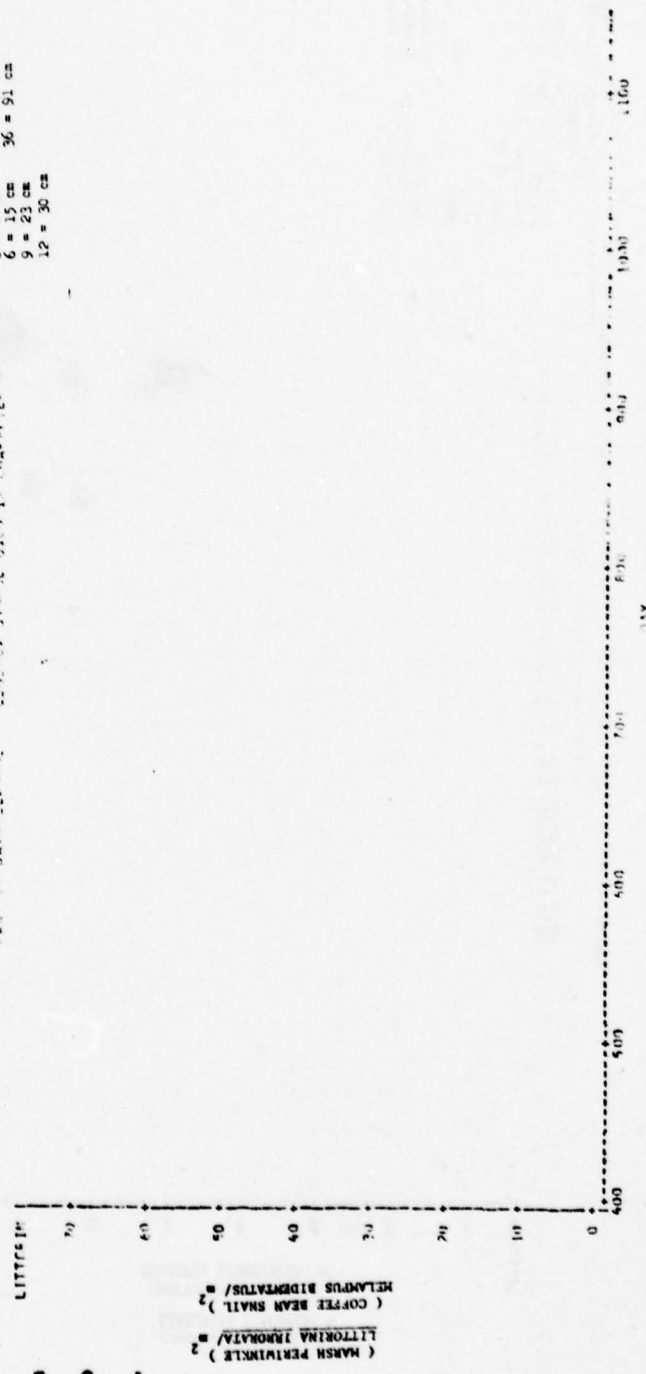
B181



WATER CONTAINING PLANT EXTRACTS IN A MEDIUM WITHIN THE PLANT

PLANT OF DAY-LIGHTING

HEIGHT  
 2 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm



B182



B183

WASH STATE UNIV. PLANT PHYSIOLOGY AND MARSH RESEARCH STATION, PULLMAN, WASH. 21, 1977

PLANT OF DAY: *PERILLA FRUTESCENS* (L.) BRITTON & A. N. S. P. 1908

HEIGHT  
3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

SOIL  
MUS  
9 = February  
12 = July  
15 = Sand & Clay  
18 = Clay

0  
10  
20  
30  
40  
50  
60  
70  
80  
90  
100

( MARSH PERENNIAL )  
LITTONIA INNOVATA / 2  
( COFFEE BEAN SNAIL )  
MELAMPUS BIDENTATUS / 2

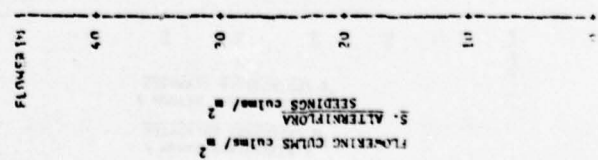
FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
1 9 7 6 1 9 7 7  
SAMPLING DATE

WILSON SWATHLESSING PLANT MATERIALS AND MACROINVERTEBRATES TO MONITOR IN LOT 22 4-DUGS-14, DIVISION 21, 1967

PLANT SPECIES COLLECTED: MONITOR  
 PLOT OF DIVISION 21, LOT 22 4-DUGS-14, DIVISION 21, 1967  
 PLOT OF DIVISION 21, LOT 22 4-DUGS-14, DIVISION 21, 1967

HEIGHT  
 3 = 8 cm 24 = 61 cm  
 6 = 15 cm 36 = 91 cm  
 9 = 23 cm 12 = 30 cm

SOIL  
 SA= Sand  
 SI= Sand & Clay  
 CL= Clay  
 MOI  
 P= February  
 J= July  
 O= November



SEEDLINGS culms/m²  
 FLOWERING culms culms/m²

B184

FEB	MAR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
		1	9	7	6									1	9	7				

SAMPLING DATE





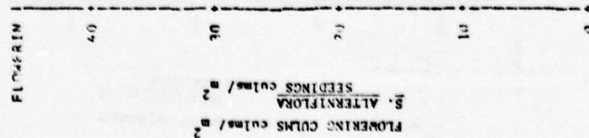
MARCH SHOOTING PLANT MATERIALS AND MECHANICAL TESTS MONITORING 1977

HEIGHTEN SOILS MONITOR

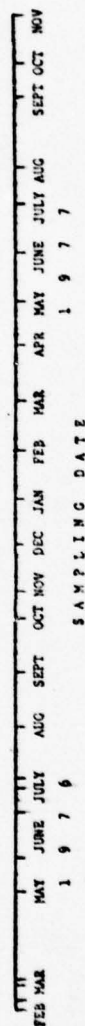
PLANT OF DIVERSITY AND LIVING: GROUND 100% IS OBSERVED

HEIGHT  
3 = 8 cm  
6 = 20 cm  
9 = 23 cm  
12 = 30 cm  
30 = 51 cm

SOIL: MCN  
D1 = Sand  
D2 = Sand & Clay  
D3 = Clay  
F = February  
J = July  
O = November



B187





B188

MASS SOUTHERN PLANT CULTIVATION AND AGROCLIMATOLOGICAL MONITORING 1953-1954, No. 21, 1957

SECTION 1. SOILS. 1953-1954  
 1.1.1. SOILS. 1953-1954  
 1.1.2. SOILS. 1953-1954

Below:  
 3 = 8 cm  
 6 = 15 cm  
 9 = 22 cm  
 12 = 30 cm

SOIL  
 1953-1954  
 1953-1954  
 1953-1954

FLOWER IN  
 0  
 1  
 2  
 3  
 4  
 5

SEEDING CULMS / m<sup>2</sup>  
 SEEDING CULMS / m<sup>2</sup>  
 SEEDING CULMS / m<sup>2</sup>

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7

SAMPLING DATE



WASH SWATHING PLANT EVALUATION AND MECHANIZATION MONITORING 1970

WASH SWATHING PLANT MONITORING

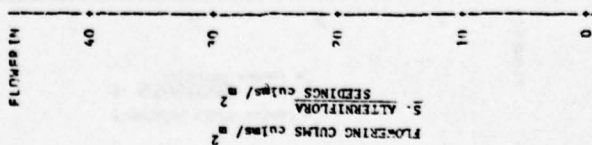
HEIGHT 24 = 61 cm  
3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

SOIL

GA = Sand  
SI = Sand & Clay  
CL = Clay

MOON

F = February  
J = July  
O = November



YEN MAY MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV

SAMPLING DATE

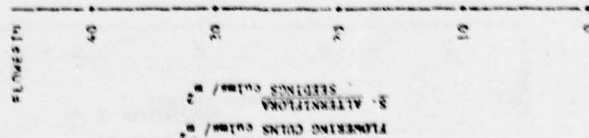
B190

MASS SOUTHERN PLANT EVALUATION AND MACROINVERTEBRATE MONITORING  
 LARRY W. DUNN, JR., DIRECTOR, 21, 1977

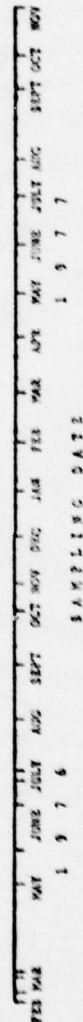
HEIGHT = 100 cm  
 SOIL = 100 cm  
 PLANT CHARACTERISTICS  
 PLANT CHARACTERISTICS

HEIGHT  
 1 = 8 cm  
 2 = 15 cm  
 3 = 23 cm  
 4 = 30 cm

SOIL  
 1 = Sand  
 2 = Sand & Clay  
 3 = Clay  
 4 = February  
 5 = July  
 6 = November



B191



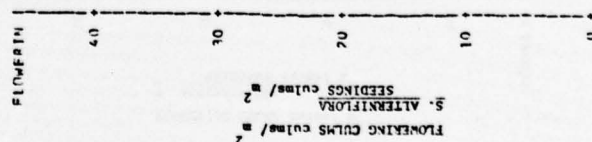


MARSH SODDING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING  
 1633 WOODS DRIVE, DECEMBER 21, 1977

HEIGHTS COLLECT M.T. (a)  
 PLOT OF DAVALLIUM (LOOSE SYMBOL USED IS CHARACTER 5)  
 PLOT OF DAVALLIUM (LOOSE SYMBOL USED IS CHARACTER 5)

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm  
 24 = 61 cm  
 36 = 91 cm

SOIL  
 S1 = Sand  
 S2 = Sand & Clay  
 C1 = Clay  
 M3  
 F = February  
 J = July  
 O = November



B192

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 SAMPLING DATE



Year	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100
1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	

[illegible]

3 = 6 cm	HEIGHT = 24 = 61 cm
6 = 15 cm	36 = 91 cm
9 = 23 cm	
12 = 30 cm	

SOIL	MON
CA= Sand	Feb February
CL= Sand & Clay	Jul July
CL= Clay	Oct November

FLowering CULMS culms/ m<sup>2</sup>  
S. ALTERNIFLORA SEEDINGS culms/ m<sup>2</sup>

FRUITFLORA  
SEEDINGS

B193

	FEB	MAR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
SAMPLING DATE																1	9	7	7		

SAMPLING DATE

MARSH SINTERING FIBRE EVALUATION AND MACROPHAGOCYTOTACTIC VOLTAGE		
176	1978 WONDERSAY, D-C MARSH 21, 1077	

$\Gamma = 10^{-4}$      $\Gamma = 7.105$      $\Gamma = 1.10134$

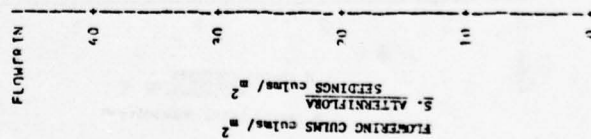
[illegible]

HEIGHT	24 =	36 =
3 = 8 cm		
6 = 15 cm		
9 = 23 cm		
12 = 30 cm		

SOIL

MOI

SA= Sand  
SI= Sand & Clay  
CL= Clay



B194

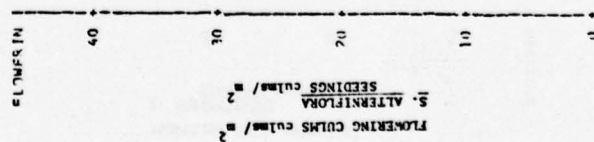
[illegible]

WASH SWOTTERING PLANT EVALUATION AND PRODUCTION MONITORING 16123 WASH SWOTTER 21, 1977

WASH SWOTTER SOIL=CL MON=0  
 PLT OF DAY=FLOWERING MON=0: 5000 10 10000-30 5  
 PLT OF DAY=FLOWERING MON=0: 5000 10 10000-30 5

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL MON  
 S1= Sand  
 S2= Sand & Clay  
 S3= Clay  
 P= February  
 J= July  
 G= November



FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 SAMPLING DATE

B195

$\text{Hf} + \text{O}_2 \rightarrow \text{HfO}_2$ 
 $\text{Sn} + \text{O}_2 \rightarrow \text{SnO}_2$ 
 $\text{Mg} + \text{O}_2 \rightarrow \text{MgO}$

[illegible]

WEIGHT

3 = 8 cm	HEIGHT	24 = 61 cm
6 = 15 cm		36 = 91 cm
9 = 23 cm		
12 = 30 cm		

7105

SA= Sand  
SI= Sand & Clay  
CL= Clay

Microfilm

SEEDINGS culms/ m<sup>2</sup>  
S. ALTERNIFLORA  
FLOWERING CULMS culms/ m<sup>2</sup>

[illegible]

MARCH SMITHSONIAN PLANT EVALUATION AND MICROINVENTORIES AT TULSA, OKLAHOMA, 1977

PLANT OF DAY-FLORIDA  
 PLOT OF DAY-FLORIDA  
 PLOT OF DAY-FLORIDA

HEIGHT  
 3 = 8 cm  
 6 = 11 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL  
 MJS  
 S1 = Sand  
 S2 = Sand & Clay  
 CL = Clay  
 F = February  
 J = July  
 O = November

FLOWERING  
 40  
 20  
 0  
 10  
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 40  
 60  
 80  
 100  
 120  
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 160  
 180  
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1977  
 21. 1977  
 21. 1977

HEIGHT  
 24 = 61 cm  
 36 = 91 cm  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL  
 CA = Sand  
 SL = Sand & Clay  
 CL = Clay  
 MO =  
 FA = February  
 JA = July  
 O = November

PLANT OR ANIMAL ORIGIN  
 1. 1977  
 1. 1977  
 1. 1977

FLOWERING CULMS culms/m<sup>2</sup>  
 5. ALTERNATE FLOWERS  
 SEEDINGS culms/m<sup>2</sup>

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 SAMPLING DATE

B200

WASH STATE UNIV. COLLEGE OF AGRICULTURE AND MECHANICAL INDUSTRIES, PULLMAN, IDAHO, 1977

PLANTING DATE: 1977

PLANTING DATE: 1977

HEIGHT

3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

SOIL

MON  
S1 = Sand  
S2 = Sand & Clay  
C1 = Clay  
F = February  
J = July  
O = October

HEIGHT

FLOWERING CULMS culms/m<sup>2</sup>  
SEEDING CULMS culms/m<sup>2</sup>

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV

SAMPLING DATE

WASH STATE PLANT CULTIVATION AND PROPAGATION DIVISION, PULLMAN, WASH. 99163

RESEARCH REPORT NO. 100

PLOT OF CEREAL PLANTS USED IN CEREAL RESEARCH

HEIGHT  
3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

SOIL  
S1 = Sand  
S2 = Sand & Clay  
C1 = Clay  
W1 = Water  
F = February  
J = July  
O = November

FLOWERING CULMS / m<sup>2</sup>  
SEEDING CULMS / m<sup>2</sup>  
SEEDING CULMS / m<sup>2</sup>

B201

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
1 9 7 6 1 9 7 7  
SAMPLING DATE



6601-12 4270439 870574000 6601  
CINCUACION DE ACCIONES EN UN FOLIO DE VOTOS PARA ELECCIONES MEXICO

$\pi_{\text{H}_2\text{O}}$   $T = 119.5$   $G = 20.174$

WEIGHT

	HEIGHT
3	8 cm
6	15 cm
24	61 cm
36	91 cm

 $24 = 61 \text{ cm}$ 

36 = 91 cm

$$\begin{aligned} 9 &= 23 \text{ cm} \\ 12 &= 30 \text{ cm} \end{aligned}$$
 $12 = 30 \text{ cm}$ 

MON

February

r = February  
 j = July

0= November

Tides

Life = Card

Silt, Sand &amp; Clay

CL- Clay

FLORATING CYLINS / m <sup>2</sup>	SEEDINGS / m <sup>2</sup>	ALTERNITORA
0.1	0.1	0.1
0.2	0.2	0.2
0.3	0.3	0.3
0.4	0.4	0.4

S. ALTERNIFLORA SEEDINGS culms / m<sup>2</sup>

B202

	FEB	MAR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DECEMBER
SAMPLING DATE			1976						1977	

SAMPLE TIME DATE





MARSH SUMMERING PLANT EVOLUTION AND MACROINVERTEBRATE MONITORING

UNIVERSITY OF ALABAMA

[illegible]

DATE 11/15/2000 BY 1010  
TIME 14:00 BY 1010

HEIGHT	
3 = 8 cm	24 = 61 cm
6 = 15 cm	36 = 91 cm
9 = 23 cm	
12 = 30 cm	

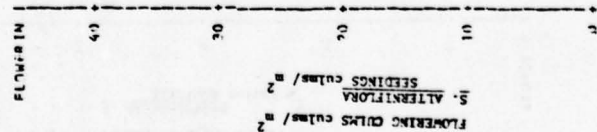
## SOIL

SOIL

SA= Sand  
SI= Sand  
CL= Clay

NOM

F= February  
J= July  
O= November



	FEB	MAR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
SAMPLING DATE			1976												1977						

**B204**

MARSH SPOTTED PLANT EVALUATION AND MANAGEMENT REPORT, 1972-1973, 21, 1977

HEIGHT: 30 cm

SOIL: SAND

HEIGHT

3 = 6 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

SOIL

CL - Sand  
CL - Sand & Clay  
CL - Clay

MOON

Feb February  
Jul July  
Nov November

FLOWER IN

SEEDING CULMS / m<sup>2</sup>  
FLOWERING CULMS CULMS / m<sup>2</sup>

B205

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
1 9 7 6 1 9 7 7

SAMPLING DATE

MARSH SAMPLING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING 16:30 WEDNESDAY, DECEMBER 21, 1977

HEIGHT: 100 cm

PLOT OF DAY-FLORIDA: 100 cm SYMBOL USED IS CHARACTER 1  
PLOT OF DAY-FLORIDA: 100 cm SYMBOL USED IS CHARACTER 1

HEIGHT  
3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

SOIL

SA = Sand  
SL = Sand & Clay  
CL = Clay  
F = February  
J = July  
O = November

FLORIDA  
40  
20  
0  
SEEDINGS culms/m<sup>2</sup>  
2  
FLOWERING culms/m<sup>2</sup>  
2

B206

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
1 9 7 6 1 9 7 7  
SAMPLING DATE



WADSWORTH SWATHING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING 16,23 WED. & SOV. 21. 1977

HEIGHT: 30 cm

PLOT OF DAVALLIA PIN LEGEND: SWATH USED IS CHARACTER F  
PLOT OF DAVALLIA PIN LEGEND: SWATH USED IS CHARACTER S

HEIGHT:

3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

SOIL

MOH

CA = Sand  
S1 = Sand & Clay  
CL = Clay  
F = February  
J = July  
O = November

FLOWERING  
40  
30  
20  
10  
0

FLOWERING CULMS / m<sup>2</sup>  
S. ALTERNIFLORA  
SEEDINGS culms / m<sup>2</sup>

B207

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV

1 9 7 6 1 9 7 7

SAMPLING DATE



WABSH BROTHERS PLANT EVALUATION AND PROPAGATION, 14123 MEDICAL WAY, OCEANA, MI 49646

HEIGHT 51" MOSE

PLANT OF BAY-SEEDING LUTHER SYMOND 1963 13

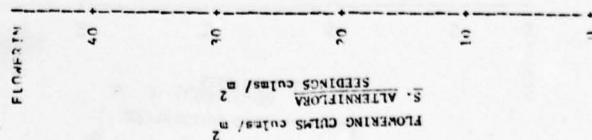
HEIGHT  
3 = 8 cm  
6 = 13 cm  
9 = 23 cm  
12 = 30 cm

SOIL

SA= Sand  
CL= Sand & Clay  
C= Clay

MOON

F= February  
J= July  
O= November



B208

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
1 9 7 6 1 9 7 7  
SAMPLING DATE

MARSH-SWAMPING PLANT EVALUATION AND MONITORING-TERRESTRIAL MONITORING (1973-1974) SOIL, DEC-MAR 21, 1977

HEIGHT SOIL (cm) (m)

PLANT DEVELOPMENT (1973) SYMBOL USED IS CHARACTERISTIC

PLANT DEVELOPMENT (1973) SYMBOL USED IS CHARACTERISTIC

HEIGHT  
24 = 61 cm  
36 = 91 cm  
12 = 30 cm

SOIL

S/S = Sand  
S/S = Sand & Clay  
C/L = Clay  
M/S = Muck  
F = February  
J = July  
O = November

FLOWERING CULMS culms/m<sup>2</sup>  
SEEDINGS culms/m<sup>2</sup>  
FLOWERING IN

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
1 9 7 6 1 9 7 7  
SAMPLING DATE

B209

MAJOR SOUTHERN PLANT EVALUATION AND MECHANIZATION MONITORING 1023 KIDDERSON, DECEMBER 21, 1977

HEIGHT 20 SOIL SET MONITOR

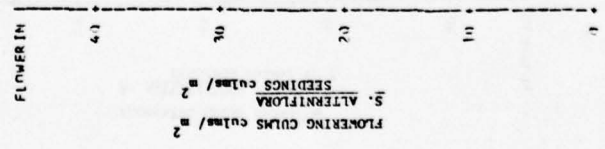
PLOT OF DIVERSIFICATION REGION SYMBOL USED IS CHARACTER 8

PLOT OF DIVERSIFICATION REGION SYMBOL USED IS CHARACTER 8

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL  
 S1 = Sand  
 S2 = Sand & Clay  
 C1 = Clay

MON  
 F = February  
 J = July  
 O = November



FLOWERING CULMS culms / m²  
 S. ALTERNIFLORA  
 SEEDING CULMS / m²

B210

PEN MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 SAMPLING DATE

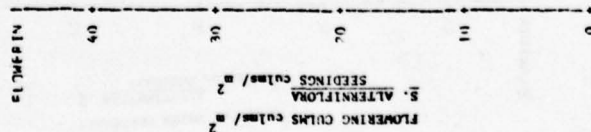
MARSH SMOTHERING PLANT EVALUATION AND MACROINVERTEBRATE MONITORING, 1977

HEIGHT=12 SOIL=CL MC=5  
 PLOT OF 24x24x24cm LEGEND SYMBOL USED IS CHARACTER F  
 PLOT OF 24x24x24cm LEGEND SYMBOL USED IS CHARACTER S

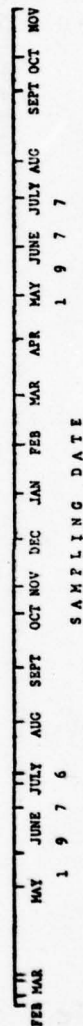
HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL  
 SM = Sand  
 CL = Sand & Clay  
 MC = Clay

MCN  
 F = February  
 J = July  
 O = November



B211



WARM SWAMPING PLANT EVALUATION AND MANAGEMENT MONITORING 1973 MONITORING, INC. 21, 1977

WETLAND SOILS

PLANT OF SWAMPING PLANT MONITORING USED IS CHARACTERISTIC

HEIGHT  
3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

SOIL

MON  
S1 = Sand  
S2 = Sand & Clay  
C1 = Clay  
P = February  
J = July  
O = November

FLOWERING CULMS / m<sup>2</sup>  
SEEDING CULMS / m<sup>2</sup>  
PLANTIN

B212

FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
1 9 7 6 1 9 7 7  
SAMPLING DATE



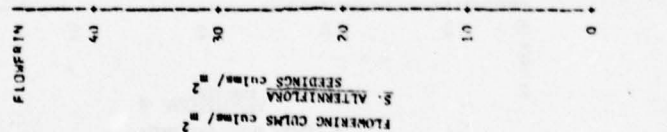
	FEB	MAR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
SAMPLING DATE			1976												1977						

[illegible]

HEIGHT

3 = 8 cm	24 = 61 cm
6 = 15 cm	36 = 91 cm
9 = 23 cm	
12 = 30 cm	

SOIL	MOE
SA= Sand	F= February
SI= Sand & Clay	J= July
CL= Clay	O= November

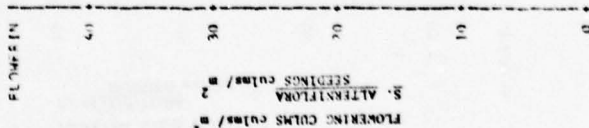


WASH. STATE UNIV. PLANT COLLECTION AND MAGNIFICATION DATA MONITORING  
 16:00 WEDNESDAY, AUGUST 21, 1957

HEIGHT 12 SOIL 12 MOISTURE 12  
 PLOT OF CAV-FLORIN LEGEND SYMBOL USED IS CAV-FLORIN 5  
 PLOT OF CAV-FLORIN LEGEND SYMBOL USED IS CAV-FLORIN 5

HEIGHT  
 3 = 6 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL  
 12 = Sand  
 21 = Sand & Clay  
 30 = Clay



B215

PLANT  
 FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 SAMPLING DATE

MOST SIGNIFICANT DISSEMINATION AND INVESTIGATIVE WORKING  
IN THE MIDDLE EAST, SEPTEMBER 21, 1977

8	6-20-90	ST	CASH	TREASURY	CHIEF CLERK	ATC	ALBANY	NY	1010
9	6-20-90	ST	CASH	TREASURY	CHIEF CLERK	ATC	ALBANY	NY	1010
			CASH	TREASURY	CHIEF CLERK	ATC	ALBANY	NY	1010

HEIGHT	
3	= 8 cm
6	= 15 cm
9	= 23 cm
12	= 30 cm
24	= 61 cm
36	= 91 cm

3 = 8 cm  
HETC™ $\epsilon = 15 \text{ cm}$ 

$9 = 23 \text{ cm}$

7165

FROM

SA = 0.002

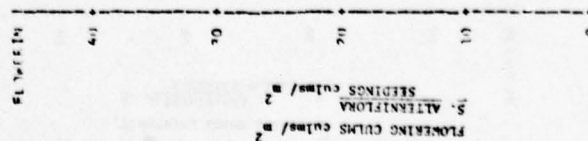
III. Sand & Clay  
I = February  
J = June

Clay Clay  
Ox November

P = February

30 July

October





WASH. BOTANICAL GARDEN, UNIVERSITY OF WASHINGTON, DECEMBER 21, 1977

HEIGHT 12 SEEDLING 100% F  
 PLOT OF DAVALLIUM USED IS CHARACTER 2  
 PLOT OF DAVALLIUM USED IS CHARACTER 2

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL

SA = Sand  
 SI = Sand & Clay  
 CL = Clay  
 M = M  
 F = February  
 J = July  
 O = November

FLOWERING  
 40  
 30  
 20  
 10  
 0

SEEDLING CULMS / m<sup>2</sup>  
 SEEDLING CULMS / m<sup>2</sup>

B217

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 SAMPLING DATE

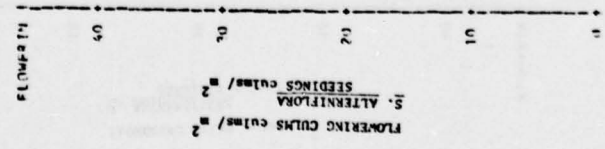


MASS SOUTHERN PLANT EVALUATION AND RESEARCH STATION, WASHINGTON, D.C. 20540, DEC. 21, 1977

HEIGHT 12 SOIL-51 MONS  
 PLOT OF DAY-SEEDING (SEEDS) PLANT 120 IS CHERRY

HEIGHT  
 3 = 6 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL MON  
 S1 = Sand  
 S2 = Sand & Clay  
 CL = Clay  
 F = February  
 J = July  
 O = November



FLOWERING CULMS culms / m<sup>2</sup>  
 SEEDINGS culms / m<sup>2</sup>

B218

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 SAMPLING DATE

WATER SAMPLING PLANT EVALUATION AND WATER QUALITY MONITORING  
 16:30 WEDNESDAY, OCTOBER 21, 1977

HEIGHT 100 cm  
 PLANT OF DAVALLIUM  
 PLANT OF DAVALLIUM

HEIGHT  
 2 = 8 cm  
 6 = 13 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL  
 100% Sand  
 100% Sand & Clay  
 100% Clay

FLOWERING CULMS / m<sup>2</sup>  
 SEEDING CULMS / m<sup>2</sup>

B219

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 SAMPLING DATE

MARSH SHOOTING BLANK EVALUATION AND MACROINVERTEBRATE MONITORING 1:00 PM WEDNESDAY, DECEMBER 21, 1977

HEIGHT = 24 SOILSOL MONOF

PLOT OF DAY-FLIGHTING LEGEND: SYMBOL USED IS CHARACTER S

HEIGHT  
 3 = 8 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL

MON  
 SA = Sand  
 SI = Sand & Clay  
 CL = Clay  
 F = February  
 J = July  
 O = November

FLOWER IN

40

FLOWERING CULMS culms/m<sup>2</sup>  
 5. ALTERNIFLORA  
 SEEDINGS culms/m<sup>2</sup>

B220

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 SAMPLING DATE

B221

MADEW SHOWING PLANT CULTIVATION AND MATURING STAGES MATURING

WATER-24, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1

PLANT OF CULTIVATION (CULTURE) SHOWING STAGES MATURING

HEIGHT  
3 = 8 cm  
6 = 15 cm  
9 = 23 cm  
12 = 30 cm

24 = 61 cm  
36 = 91 cm

SOIL

SA = Sand  
SLS = Sand & Clay  
CL = Clay  
MSW  
F = February  
J = July  
O = October

FLOWERING CULMS / m<sup>2</sup>  
SEEDING CULMS / m<sup>2</sup>  
S. ALTERNIFLORA  
FLOWERING CULMS / m<sup>2</sup>  
SEEDING CULMS / m<sup>2</sup>

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV

SAMPLING DATE



FLORING GUINIS column / m  
B. ALTERNIFLORA  
SEEDING column / m

11. ALL INFORMATION CONTAINED HEREIN IS UNCLASSIFIED

[illegible]



1661-1747, 1747-1748, 1748-1749, 1749-1750, 1750-1751, 1751-1752, 1752-1753, 1753-1754, 1754-1755, 1755-1756, 1756-1757, 1757-1758, 1758-1759, 1759-1760, 1760-1761, 1761-1762, 1762-1763, 1763-1764, 1764-1765, 1765-1766, 1766-1767, 1767-1768, 1768-1769, 1769-1770, 1770-1771, 1771-1772, 1772-1773, 1773-1774, 1774-1775, 1775-1776, 1776-1777, 1777-1778, 1778-1779, 1779-1780, 1780-1781, 1781-1782, 1782-1783, 1783-1784, 1784-1785, 1785-1786, 1786-1787, 1787-1788, 1788-1789, 1789-1790, 1790-1791, 1791-1792, 1792-1793, 1793-1794, 1794-1795, 1795-1796, 1796-1797, 1797-1798, 1798-1799, 1799-1800, 1800-1801, 1801-1802, 1802-1803, 1803-1804, 1804-1805, 1805-1806, 1806-1807, 1807-1808, 1808-1809, 1809-1810, 1810-1811, 1811-1812, 1812-1813, 1813-1814, 1814-1815, 1815-1816, 1816-1817, 1817-1818, 1818-1819, 1819-1820, 1820-1821, 1821-1822, 1822-1823, 1823-1824, 1824-1825, 1825-1826, 1826-1827, 1827-1828, 1828-1829, 1829-1830, 1830-1831, 1831-1832, 1832-1833, 1833-1834, 1834-1835, 1835-1836, 1836-1837, 1837-1838, 1838-1839, 1839-1840, 1840-1841, 1841-1842, 1842-1843, 1843-1844, 1844-1845, 1845-1846, 1846-1847, 1847-1848, 1848-1849, 1849-1850, 1850-1851, 1851-1852, 1852-1853, 1853-1854, 1854-1855, 1855-1856, 1856-1857, 1857-1858, 1858-1859, 1859-1860, 1860-1861, 1861-1862, 1862-1863, 1863-1864, 1864-1865, 1865-1866, 1866-1867, 1867-1868, 1868-1869, 1869-1870, 1870-1871, 1871-1872, 1872-1873, 1873-1874, 1874-1875, 1875-1876, 1876-1877, 1877-1878, 1878-1879, 1879-1880, 1880-1881, 1881-1882, 1882-1883, 1883-1884, 1884-1885, 1885-1886, 1886-1887, 1887-1888, 1888-1889, 1889-1890, 1890-1891, 1891-1892, 1892-1893, 1893-1894, 1894-1895, 1895-1896, 1896-1897, 1897-1898, 1898-1899, 1899-1900, 1900-1901, 1901-1902, 1902-1903, 1903-1904, 1904-1905, 1905-1906, 1906-1907, 1907-1908, 1908-1909, 1909-1910, 1910-1911, 1911-1912, 1912-1913, 1913-1914, 1914-1915, 1915-1916, 1916-1917, 1917-1918, 1918-1919, 1919-1920, 1920-1921, 1921-1922, 1922-1923, 1923-1924, 1924-1925, 1925-1926, 1926-1927, 1927-1928, 1928-1929, 1929-1930, 1930-1931, 1931-1932, 1932-1933, 1933-1934, 1934-1935, 1935-1936, 1936-1937, 1937-1938, 1938-1939, 1939-1940, 1940-1941, 1941-1942, 1942-1943, 1943-1944, 1944-1945, 1945-1946, 1946-1947, 1947-1948, 1948-1949, 1949-1950, 1950-1951, 1951-1952, 1952-1953, 1953-1954, 1954-1955, 1955-1956, 1956-1957, 1957-1958, 1958-1959, 1959-1960, 1960-1961, 1961-1962, 1962-1963, 1963-1964, 1964-1965, 1965-1966, 1966-1967, 1967-1968, 1968-1969, 1969-1970, 1970-1971, 1971-1972, 1972-1973, 1973-1974, 1974-1975, 1975-1976, 1976-1977, 1977-1978, 1978-1979, 1979-1980, 1980-1981, 1981-1982, 1982-1983, 1983-1984, 1984-1985, 1985-1986, 1986-1987, 1987-1988, 1988-1989, 1989-1990, 1990-1991, 1991-1992, 1992-1993, 1993-1994, 1994-1995, 1995-1996, 1996-1997, 1997-1998, 1998-1999, 1999-2000, 2000-2001, 2001-2002, 2002-2003, 2003-2004, 2004-2005, 2005-2006, 2006-2007, 2007-2008, 2008-2009, 2009-2010, 2010-2011, 2011-2012, 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018, 2018-2019, 2019-2020, 2020-2021, 2021-2022, 2022-2023, 2023-2024, 2024-2025, 2025-2026, 2026-2027, 2027-2028, 2028-2029, 2029-2030, 2030-2031, 2031-2032, 2032-2033, 2033-2034, 2034-2035, 2035-2036, 2036-2037, 2037-2038, 2038-2039, 2039-2040, 2040-2041, 2041-2042, 2042-2043, 2043-2044, 2044-2045, 2045-2046, 2046-2047, 2047-2048, 2048-2049, 2049-2050, 2050-2051, 2051-2052, 2052-2053, 2053-2054, 2054-2055, 2055-2056, 2056-2057, 2057-2058, 2058-2059, 2059-2060, 2060-2061, 2061-2062, 2062-2063, 2063-2064, 2064-2065, 2065-2066, 2066-2067, 2067-2068, 2068-2069, 2069-2070, 2070-2071, 2071-2072, 2072-2073, 2073-2074, 2074-2075, 2075-2076, 2076-2077, 2077-2078, 2078-2079, 2079-2080, 2080-2081, 2081-2082, 2082-2083, 2083-2084, 2084-2085, 2085-2086, 2086-2087, 2087-2088, 2088-2089, 2089-2090, 2090-2091, 2091-2092, 2092-2093, 2093-2094, 2094-2095, 2095-2096, 2096-2097, 2097-2098, 2098-2099, 2099-2100, 2100-2101, 2101-2102, 2102-2103, 2103-2104, 2104-2105, 2105-2106, 2106-2107, 2107-2108, 2108-2109, 2109-2110, 2110-2111, 2111-2112, 2112-2113, 2113-2114, 2114-2115, 2115-2116, 2116-2117, 2117-2118, 21

$$C = N_{\Sigma}^{\text{tot}} \quad \gamma_{\Sigma}^{\text{tot}} = 1/\omega_{\Sigma}^{\text{tot}} \quad \gamma_{\Sigma} = \Delta T / \Delta t \approx 1/2$$

PLOT OF CAVFLOW.PRM  
 PLOT OF CAVACFID.PRM  
 LIGAND: SYMOL USED  
 LIGAND: SYMOL USED  
 LIGAND: SYMOL USED  
 LIGAND: SYMOL USED

## DISCUSSION

HEIGHT	
3 = 8 cm	24 = 61 cm
6 = 15 cm	36 = 91 cm
9 = 22 cm	

 $24 = 62 \text{ cm}$  $36 = 91 \text{ cm}$ 

12 = 30 cm

## 7105

# MOM

SA= Sand

S1= Sand &amp; Clay

CL- Clay

Feb. February

J= July

O = November

5. ALTERNIFLORA SEEDINGS culms/m<sup>2</sup>

S. ALTERNIFLORA

Flowchart

**B223**

MARSH SMOOTHING PLANT EVALUATION AND MANAGEMENT REPORT MONITORING 16123 WEDNESDAY, DECEMBER 21, 1977

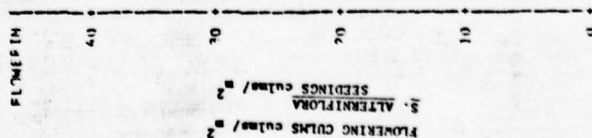
HEIGHT=24 SOIL=ST MOH=Q

PLOT OF DEWATERING LEGEND: SYMBOL USED IS CHARACTER S

HEIGHT  
3 = 8 cm 24 = 61 cm  
6 = 15 cm 36 = 91 cm  
9 = 23 cm  
12 = 30 cm

SOIL

MOH  
S1 = Sand  
S2 = Sand & Clay  
C1 = Clay  
F = February  
J = July  
O = November



B224

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
1 9 7 6 1 9 7 7  
SAMPLING DATE

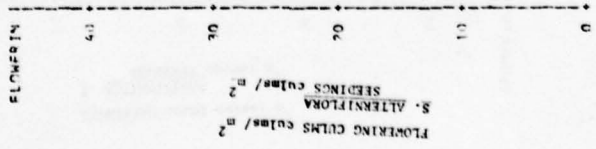
WASH STATE PLANT EVALUATION AND RESEARCH STATION, WASHINGTON, 209  
 1977

HEIGHTS, 1977

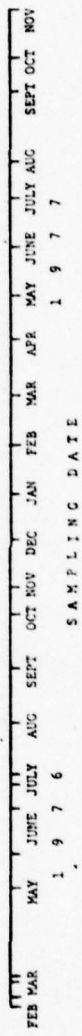
PLANT OF DAY-SEEDING 1977

HEIGHT  
 3 = 6 cm  
 6 = 15 cm  
 9 = 23 cm  
 12 = 30 cm

SOIL  
 S1 = Sand  
 S2 = Sand & Clay  
 CL = Clay  
 M1 = February  
 M2 = July  
 M3 = November



B225



SAMPLING DATE

B226

FLOWERING CULMS culms/m<sup>2</sup>  
 SEEDINGS culms/m<sup>2</sup>  
 S. ALTERNIFLORA  
 NI DEPTH IN

MASSCH SMOTHERING DEATH EVALUATION AND MACROINVERTEBRATE MONITORING 16:23 MEDIAN SOIL, CLEWELL 21, 1977

HEIGHT=16 SOIL=CL MOW=J  
 PLOT OF DAY-SEEDING LEGEND: SYMBOL USED IS CHARACTER S

HEIGHT  
 3 = 8 cm 24 = 61 cm  
 6 = 15 cm 30 = 91 cm  
 9 = 23 cm  
 12 = 23 cm

SOIL  
 SA= Sand  
 SL= Sand & Clay  
 CL= Clay  
 MOW  
 Fe February  
 Ju July  
 Oc November

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 SAMPLING DATE



WATER SAMPLING PLANT EVALUATION AND WATER QUALITY MONITORING, 1968-1969, 21, 1977

WATER QUALITY MONITORING  
 LEGEND: SYMBOL USED IS CHARACTER  
 OF CHARACTER

HEIGHT  
 3- 3 inches  
 6- 6 inches  
 9- 9 inches  
 12- 12 inches

SOIL  
 S= Sand  
 C= Clay  
 S&C= Sand & Clay  
 F= February  
 J= July  
 N= November

FLOWERING  
 SEEDING CULMS / m<sup>2</sup>  
 SEEDING CULMS / m<sup>2</sup>

FEB MAR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV  
 1 9 7 6 1 9 7 7  
 SAMPLING DATE



## APPENDIX C

### ANALYSIS OF VARIANCE FOR BIOMASS AND CULM DENSITY IN MARSH SMOTHERING ENCLOSURES

#### Legend for Dependent Variable Codes

Bhio	=	Dead material biomass gdw /m <sup>2</sup>
L bio	=	Live material biomass gdw /m <sup>2</sup>
Biomass	=	Combined Live and dead biomass gdw /m <sup>2</sup>
L den	=	Live culms /m <sup>2</sup>
D den	=	Dead culms /m <sup>2</sup>

#### Legend for Class Variable Codes

<u>Height</u>	=	Enclosure height
3	=	8 cm
6	=	15 cm
9	=	23 cm
12	=	30 cm
24	=	61 cm
36	=	91 cm
<u>Soil</u>	=	Dredged Material type
SA	=	Sand
SI	=	Sand and Clay
CL	=	Clay
<u>Mon</u>	=	Month of Deposition
F	=	February 1976
J	=	July 1976
0	=	November 1976

Control

0 = Experimental Enclosures ( $0.656 \text{ m}^2$ )

1 = Control Enclosures ( $0.656 \text{ m}^2$ )

PART 1

Analysis of Variance

General Linear Model

April and November 1977 data.

PART 1

C3

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
HEIGHT	6	3 6 9 12 24 30
SOIL	3	CL SA SI
MON	3	F J O
CONT	2	0 1

NUMBER OF OBSERVATIONS IN DATA SET = 210

GROUP	OBS	DEPENDENT VARIABLES
1	218	DRIO LBIO RIOMASS
2	215	LGEN
3	170	DBEN

NOTE: VARIABLES IN EACH GROUP ARE CONSISTENT WITH RESPECT TO THE PRESENCE OR ABSENCE OF MISSING VALUES.

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: D610

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	55	3102758.53792E07	5642.61392E17	1.92	0.0010	0.233378	98.5669
ERROR	154	4091712.04450E03	30437.20656E29		STD DEV		0.010 *1E4
CORRECTED TOTAL	217	8094470.58248E07			174.4627994		177.066155L

SOURCE	DF	TYPE I SS	F VALUE	FM > F	DF	TYPE IV SS	F VALUE	FM > F
HEIGHT	5	344715.18430598	2.27	0.0469	5*	239042.97588853	1.57	0.1663
SOIL	2	21168.90320710	0.35	0.7068	2*	29115.55102264	0.48	0.6217
HEIGHT*SOIL	10	186485.58794744	0.61	0.8016	10*	254019.71105216	0.63	0.5600
NON	2	427617.30105612	7.02	0.0012	2*	490074.65445276	0.07	0.9005
HEIGHT*NON	7	245566.70769078	1.15	0.3324	6*	70878.61925912	0.29	0.5961
SOIL*NON	4	99731.20871574	0.22	0.5167	4*	93069.69985599	0.28	0.5961
HEIGHT*SOIL*NON	12	195709.92615557	0.54	0.8890	12	269779.70445540	0.66	0.5961
HEIGHT*SOIL	1	1129655.96549798	37.11	0.0001	1*	1157472.33786600	38.03	0.0001
HEIGHT*NON	3	129253.57852013	1.42	0.2490	3*	1187674.34876473	1.20	0.3112
SOIL*NON	2	66031.46665123	1.05	0.3515	2*	1187674.34876473	1.20	0.3112
HEIGHT*SOIL*NON	5	256.0240776405	1.70	0.1361	5*	256766.577778495	1.70	0.1361
HEIGHT*SOIL	0	0.00000000	.	.	0	0.00000000	.	.
HEIGHT*NON	0	0.00000000	.	.	0	0.00000000	.	.
SOIL*NON	0	0.00000000	.	.	0	0.00000000	.	.
HEIGHT*SOIL*NON	0	0.00000000	.	.	0	0.00000000	.	.

\* NOTES WHEN THE IV TESTABLE HYPOTHESES EXIST WHICH MAY YIELD DIFFERENT SS.



GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: LRIQ

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	53	8584014.04175884	158126.64418419	2.40	0.0001	0.436505	47.4122
ERROR	154	10823108.84673354	6994.5647924		STD DEV		LRIQ MEAN
CONNECTED TOTAL	217	19207122.88849243			256.89407572		541.83119666

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
HEIGHT	5	2831823.69417799	8.58	0.0001	5*	792982.65082613	2.40	0.0388
SOIL	2	764776.56823331	5.79	0.0037	2*	75273.33050144	0.62	0.0017
HEIGHT*SOIL	10	985293.43866334	14.9	0.0001	10*	587920.87483756	0.89	0.5431
CON	2	132873.27881579	1.01	0.3677	2*	309914.00886574	2.35	0.0988
HEIGHT*CON	7	117428.37831031	0.24	0.9688	6*	259768.86618040	0.61	0.7257
SOIL*CON	4	49763.77226273	0.19	0.9441	4*	192740.51208540	0.73	0.5726
HEIGHT*SOIL*CON	12	50760.17014622	0.63	0.8113	12	654896.58658021	0.83	0.6225
CON	1	147708.24864787	22.24	0.0001	1*	1457012.1684845	22.00	0.0001
HEIGHT*CON	5	403801.37126705	3.52	0.0163	5*	455798.29588772	2.70	0.0885
SOIL*CON	2	403801.37126705	3.52	0.0163	2*	354155.26926556	2.68	0.0714
HEIGHT*SOIL*CON	10	403801.37126705	1.30	0.2636	10	430545.3104560	1.50	0.2656
CON	0	0.00000000			0	0.00000000		
HEIGHT*CON	0	0.00000000			0	0.00000000		
SOIL*CON	0	0.00000000			0	0.00000000		
HEIGHT*SOIL*CON	0	0.00000000			0	0.00000000		

\* NOTE: OTHER TYPE IV TESTABLE HYPOTHESES EXIST WHICH MAY YIELD DIFFERENT SS.

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: BIOMASS

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	53	14494245.11362378	273476.32269479	2.23	0.0001	0.416638	48.7559
ERROR	164	20146680.09512055	122833.41521415		STD DEV		BIOMASS MEAN
CORRECTED TOTAL	217	34638925.20854434			350.47594379		716.83779417

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
HEIGHT	5	2492039.5533276	4.06	0.0018	5*	1051989.72393871	1.71	0.1332
SOIL	2	871109.43095383	3.55	0.0311	2*	1167725.00237262	4.75	0.0068
HEIGHT*SOIL	10	1469544.78534899	1.20	0.2974	10*	192551.76453597	0.62	0.7915
CON	2	1050588.67788978	4.22	0.0163	2*	187033.53453052	0.60	0.0025
HEIGHT*CON	7	206269.6871525	0.24	0.9729	7*	368182.61456309	0.71	0.5522
SOIL*CON	4	26662.64600504	0.59	0.6840	4*	1055836.44100160	0.72	0.5671
HEIGHT*SOIL*CON	12	837766.10430723	42.31	0.0001	12*	5202186.95423315	42.35	0.0001
CON	1	51723.772754282	2.93	0.0881	1*	767958.07888900	2.08	0.1528
HEIGHT*CON	3	106829.45482084	2.42	0.0918	3*	483369.78870236	1.97	0.1431
SOIL*CON	2	57529.45482084	0.83	0.5349	2*	507068.10417141	0.83	0.5349
HEIGHT*SOIL*CON	6	507068.10417141			6	0.00000000		
CON	0	0.00000000			0	0.00000000		
HEIGHT*CON	0	0.00000000			0	0.00000000		
SOIL*CON	0	0.00000000			0	0.00000000		
HEIGHT*SOIL*CON	0	0.00000000			0	0.00000000		

\* NOTE: OTHER TYPE IV TESTABLE HYPOTHESES EXIST WHICH MAY YIELD DIFFERENT SS.

STATISTICAL ANALYSIS SYSTEM 12:08 THURSDAY, APRIL 27, 1978 5

GENERAL LINEAR MODELS PROCEDURE  
DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE DHIO

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=164 MS=50437.3

GROUPING	MEAN	N	HEIGHT
A	316.874286	7	36
A	295.060000	6	24
A	199.943846	52	12
A	184.185660	53	9
A	149.255200	50	3
A	140.385600	50	6

STATISTICAL ANALYSIS SYSTEM 12:08 THURSDAY, APRIL 20, 1976 6

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE LRIO

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=164 MS=65994.6

GROUPING	MEAN	N	HEIGHT
A	914.906657	6	24
B	665.115200	50	3
B	616.086400	50	6
B	523.482264	53	9
C	390.141077	52	12
C	371.097143	7	36

GENERAL LINEAR MODELS PROCEDURE  
DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE BIOMASS

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=164 PS=122933

GROUPING	MEAN	N	HEIGHT
A	1199.966667	6	24
B	774.370400	50	3
B	756.472000	50	6
B	707.667925	53	9
C	681.971429	7	36
C	590.086923	52	12



STATISTICAL ANALYSIS SYSTEM 12:08 THURSDAY, APRIL 20, 1978 2

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE OHIO

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL = .05 DF = 164 F5 = 504.57, 5

GROUPING	MEAN	N	SOIL
A	186.516316	76	SA
A	184.191304	69	CL
A	160.002740	73	SI

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE LBIO

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=164 PS=65994.6

GROUPING	MEAN	N	SOIL
A	624.125217	69	CL
B	514.219062	73	SI
B	493.640000	76	SA

STATISTICAL ANALYSIS SYSTEM 12:02 THURSDAY, APRIL 20, 1978 10

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE BIOMASS

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=164 MS=122433

GROUPING	MEAN	N	SOIL
A	608.116522	69	CL
U	680.456316	76	SA
B	674.220822	73	SI

STATISTICAL ANALYSIS SYSTEM 12:08 THURSDAY, APRIL 20, 1978 11

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE DB10

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=164 PS=30437.3

GROUPING	MEAN	N	PON
A	214.433000	60	0
A	205.720563	71	F
B	101.890149	67	J

STATISTICAL ANALYSIS SYSTEM 12:08 THURSDAY, APRIL 20, 1978 14

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE LNU

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=164 F=6594.6

GROUPING	MEAN	N	MIN
A	564.262001	80	0
A	555.206761	71	F
A	500.874030	67	J



STATISTICAL ANALYSIS SYSTEM 12:00 THURSDAY, APRIL 20, 1976 13

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE BIOMASS

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=164 PS=122411

GROUPING	MEAN	N	MIN
A	778.69500E	MO	O
A	760.927324	71	F
B	602.764179	67	J

STATISTICAL ANALYSIS SYSTEM 12:00 THURSDAY, APRIL 04, 1979 14

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE DM10

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05		DF=1/6	MS=30432.5		
GROUPING	MEAN	N	CONT		
A	55.54000	36	0		
B	142.04600	182	1		

STATISTICAL ANALYSIS SYSTEM 12:00 THURSDAY, APRIL 20, 1976 15

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE LRI0

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=164 PS=65994.6

GROUPING	MEAN	N	CONT
A	714.400000	36	0
U	507.698703	182	1

STATISTICAL ANALYSIS SYSTEM 12:08 THURSDAY, APRIL 20, 1978 16

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE DIAMASS

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=164 F=122.33

GROUPING	MEAN	N	CONT
A	1067.93600	36	0
B	649.786593	182	1

S T A T I S T I C A L   A N A L Y S I S   S Y S T E M   12:08 THURSDAY, APRIL 20, 1976   17

GENERAL LINEAR MODELS PROCEDURE

MEANS

HEIGHT   SOIL   N   DBIO   LPI0   BIOMASS

1	CL	15	141.506667	571.72267	713.22933
3	SA	17	146.74529	628.20706	774.50559
3	SI	18	143.61778	666.67859	808.10667
6	CL	15	191.62155	740.16155	933.76767
6	SA	18	145.47555	618.89555	764.26667
6	SI	17	189.96759	503.47765	555.64471
9	CL	17	161.72467	677.56000	799.67111
9	SA	17	195.16867	496.84444	603.11155
9	SI	18	175.28867	470.27111	628.01111
12	CL	18	175.28867	496.84444	645.85778
12	SA	17	236.18870	353.44471	554.52941
12	SI	17	189.56794	342.30000	531.56294
24	CL	2	438.160000	1181.04000	1619.20000
24	SA	2	197.600000	636.12000	823.72000
24	SI	2	259.420000	897.56000	1156.98000
36	CL	2	316.500000	519.09000	833.58000
36	SA	4	290.200000	274.36000	564.58000
36	SI	1	396.320000	462.18000	844.60000

HEIGHT   MON   N   DBIO   LPI0   BIOMASS

3	F	17	229.692941	606.65824	836.65176
3	J	18	74.553333	620.59222	695.45556
3	U	15	147.036667	651.472000	776.50667
6	F	17	164.098824	681.71767	843.51647
6	J	16	45.180000	553.755000	598.95500
6	U	17	208.277647	609.520000	817.79765
9	F	18	237.304444	527.35556	744.66444
9	J	17	135.60329	495.430558	633.09412
9	U	18	176.48444	546.17222	727.17222
12	F	16	254.13555	316.100000	433.54000
12	J	16	154.13555	316.100000	422.21720
12	U	18	239.184444	412.104444	651.58889
24	F	6	795.760000	904.506667	1195.96667
24	J	1	51.000000	266.100000	297.00000
24	U	6	357.520000	581.615333	746.13333

HEIGHT   CONT   N   DBIO   LPI0   BIOMASS

3	U	6	265.160000	631.11333	807.17333
3	F	44	633.422777	762.20000	797.62556
3	J	4	107.140000	597.44167	1174.66000
6	U	4	280.100000	798.75000	699.46273
6	F	1	171.915765	486.24426	660.25617
6	J	47	500.500000	407.506667	1310.70667
12	U	6	166.201756	235.291334	496.16304
12	F	46	366.760000	604.500000	1199.66667
24	U	6	275.760000	604.500000	1199.66667



STATISTICAL ANALYSIS SYSTEM 12:05 THURSDAY, APRIL 20, 1978 12

GENERAL LINEAR MODELS PROCEDURE

MEANS

HEIGHT	CONT	N	DB10	LB10	BIOMASS
46	U	6	352.520000	488.415555	766.17735
56	T	1	41.000000	246.100000	297.000000

SOIL	MOV	N	DB10	LB10	BIOMASS
CL	F	24	236.660000	647.015555	877.673333
CL	J	21	21.296190	537.066667	609.862857
CL	O	24	236.768333	677.415555	913.481667
SA	F	24	177.425000	502.233333	676.658333
SA	J	23	140.525217	497.566666	636.395555
SA	O	29	238.330000	543.411111	714.714444
SI	F	23	206.220000	574.555555	723.777777
SI	J	23	96.782174	471.333333	563.846667
SI	O	27	177.092963	550.521671	777.634444

S T A T I S T I C A L   A N A L Y S I S   S Y S T E M   12:08 THURSDAY, APRIL 20, 1978   14  
GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: LORN

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C-V.
MODEL	51	2259700.51023256	42635.86661616	3.26	0.0001	0.517952	48.5817
ERROR	161	2103060.60000100	13062.48447205		STD DEV		UDF. MEAN
CORRECTED TOTAL	214	4362760.51023256			114.29127658		235.25581795

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
HEIGHT	5	414356.65658348	6.34	0.0001	5*	475590.11525750	7.28	0.0001
SOIL	2	68698.03919539	2.63	0.0752	2*	129330.08001328	4.95	0.0002
HEIGHT*SOIL	10	243411.85536872	1.86	0.0539	10*	318415.27455529	2.44	0.0099
MON	2	162962.93554623	6.24	0.0025	2*	71615.30707950	2.74	0.0075
HEIGHT*MON	7	76085.27303372	0.83	0.5634	6*	54637.24960694	0.70	0.6523
SOIL*MON	4	138428.92204353	2.65	0.0353	4*	100244.04450174	7.03	0.0022
HEIGHT*SOIL*MON	12	23381.93508315	0.53	0.9507	12	66891.07264410	0.43	0.9511
CONT	1	402107.22051282	30.78	0.0001	1*	402107.22051282	53.43	0.0001
HEIGHT*CONT	5	24800.26552626	0.48	0.9342	5*	24800.26552626	0.31	0.9342
SOIL*CONT	2	109120.26552626	11.84	0.0001	2*	160711.46537231	92.99	0.0001
HEIGHT*SOIL*CONT	5	101743.68458350	1.56	0.1738	5*	250640.94538464	1.26	0.0003
MON*CONT	4	0.00000000	.	.	4	101743.68458350	.	0.1738
HEIGHT*MON*CONT	10	0.00000000	.	.	10	0.00000000	.	.
SOIL*MON*CONT	2	0.00000000	.	.	2	0.00000000	.	.
HEIGHT*SOIL*MON*CONT	0	0.00000000	.	.	0	0.00000000	.	.

\* NOTE: OTHER TYPE IV TESTABLE HYPOTHESES EXIST WHICH MAY YIELD DIFFERENT SS.

GENERAL LINEAR MODELS PROCEDURE  
DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE LOEN

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=161 MS=13062.5

GROUPING	MEAN	N	HEIGHT
A	316.64667	6	24
A	264.80000	50	3
A	263.01886	53	9
A	242.80000	50	6
B	175.51020	49	12
B	108.57429	7	16

STATISTICAL ANALYSIS SYSTEM 12:00 THURSDAY, APRIL 21, 1972 21

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE LDEN

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=161 PS=13062.5

GROUPING	MEAN	N	SOIL
A	252.058824	64	CL
A	245.205479	73	SI
B	210.000000	74	SA

STATISTICAL ANALYSTS SYSTEM 12:08 THURSDAY, APRIL 20, 1978 44

GENERAL LINEAR MODELS PROCEDURE

DUYCAN'S MULTIPLE RANGE TEST FOR VARIABLE LDEN

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 UF=161 F5=13067.5

GROUPING	MEAN	N	MIN
A	260.512871	78	0
A	241.402451	71	F
G	198.727279	46	J



STATISTICAL ANALYSIS SYSTEM 12:09 THURSDAY, APRIL 20, 1972 23

GENERAL LINEAR MODELS PROCEDURE  
DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE LDEN

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05		DF=167	PS=15062.5		
GROUPING	MEAN	N	CONT		
A	314.857143	35	0		
B	219.000000	180	1		

GENERAL LINEAR MODELS PROCEDURE

WALD

HEIGHT	SOIL	#	LDEN
3	CL	15	216.100000
7	SA	17	263.120412
7	SI	12	306.666667
6	CL	15	262.666667
5	SA	18	250.100000
6	SI	17	217.647059
6	CL	17	336.470588
9	SA	12	185.555556
9	SI	18	271.111111
12	CL	17	192.941176
12	SA	15	156.100000
12	SI	17	175.294118
24	CL	2	330.100000
24	SA	2	260.100000
24	SI	2	556.100000
35	CL	2	150.100000
35	SA	4	90.100000
35	SI	1	100.100000

HEIGHT	SOIL	#	LDEN
3	F	17	260.100000
3	J	12	257.100000
3	O	15	282.100000
6	F	17	255.294118
6	J	16	212.100000
6	O	17	255.294118
7	F	18	256.666667
9	J	17	176.470588
9	O	17	337.222222
12	F	18	192.100000
12	J	15	175.294118
12	O	16	196.294118
24	F	6	317.666667
24	J	1	120.100000
35	F	6	176.666667

HEIGHT	SOIL	#	LDEN
3	F	6	255.666667
3	J	44	265.555556
6	F	6	321.100000
6	J	44	252.222222
9	F	6	555.555556
9	J	67	223.217391
12	F	5	602.100000
12	J	46	153.100000
24	F	6	216.666667

STATISTICAL ANALYSIS SYSTEM 12:08 THURSDAY, APRIL 20, 1978 43

GENERAL LINEAR MODELS PROCEDURE

MEANS

HEIGHT	CONT	N	LDEN
36	0	6	106.46667
35	1	1	120.18000

SOIL	MON	N	LDEN
CL	F	24	250.83333
CL	J	21	189.52381
CL	0	23	310.47678
SA	F	24	235.00000
SA	J	22	210.90909
SA	0	28	187.85714
SI	F	23	236.26087
SI	J	23	195.62174
SI	0	27	293.33333

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: EDEN

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	P-SQUARE	C.V.
MODEL	52	761321.17647352	14636.25471156	2.72	0.0001	0.545651	60.2330
ERROR	117	635760.11003702	5436.5813658		SEE DEV		DEEN MEAN
CORRECTED TOTAL	169	1396981.27647054			74.59762656		121.4116471

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
HEIGHT	5	155234.64742912	5.73	0.0001	5*	108241.06730110	4.00	0.0023
EDEN	2	11264.56403800	1.04	0.3569	2*	6785.63847175	0.63	0.5353
HEIGHT*SOIL	10	51162.70202791	1.68	0.0927	10*	84158.51658537	1.55	0.1752
SOIL	2	136155.64332976	12.57	0.0001	2*	67460.61191661	6.23	0.0127
HEIGHT*SOIL*EDEN	7	15676.67111508	2.21	0.0383	7*	9496.28666231	0.29	0.9390
SOIL*EDEN	4	6746.83167203	0.45	0.7717	4*	12561.81542319	0.56	0.6765
HEIGHT*SOIL*EDEN	12	56164.31663375	0.86	0.5856	11*	20328.69181115	0.34	0.9740
COAT	1	123460.39215588	22.87	0.0001	1*	164409.67741936	27.03	0.0001
HEIGHT*COAT	2	27494.60384314	1.69	0.1709	2*	28976.27684346	1.72	0.1543
SOIL*COAT	2	23462.54244635	2.16	0.1194	2*	25934.54105534	2.39	0.0957
HEIGHT*SOIL*COAT	4	4766.24570362	1.59	0.1922	4*	42847.45703362	1.98	0.1162
SOIL*COAT*EDEN	0	0.00000000	.	.	0	0.00000000	.	.
HEIGHT*SOIL*COAT*EDEN	0	0.00000000	.	.	0	0.00000000	.	.
SOIL*COAT*EDEN	0	0.00000000	.	.	0	0.00000000	.	.
HEIGHT*SOIL*COAT*EDEN	0	0.00000000	.	.	0	0.00000000	.	.

\* NOTE: OTHER TYPE IV TESTABLE HYPOTHESES EXIST WHICH MAY YIELD DIFFERENT SS.

GENERAL LINEAR MODELS PROCEDURE  
DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE DDEN

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=117 F5=5410.58

GROUPING	MEAN	N	HEIGHT
A	157.647059	34	12
A	150.000000	6	24
A	149.473684	38	9
A	128.571429	7	36
A	94.871795	39	6
A	89.110435	46	5



STATISTICAL ANALYSIS SYSTEM 12:06 THURSDAY, APRIL 20, 1978 28

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE DDFN

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=17 MS=5416.54

GROUPING	MEAN	N	SOIL
A	154.00000	50	CL
A	120.00000	55	SI
A	112.92507	65	SA

STATISTICAL ANALYSIS SYSTEM 12:05 THURSDAY, APRIL 20, 1978 25

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE DDEN

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=117 SS=5616.5M

GROUPING	MEAN	N	PON
A	151.612903	62	0
A	128.396729	61	F
B	72.765957	47	J

STATISTICAL ANALYSIS SYSTEM 12:00 THURSDAY, APRIL 26, 1979 20

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE DDEN

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=117 MS=5416.58

GROUPING	MEAN	N	CONT
A	117.22222	36	0
B	113.74343	134	1

STATISTICAL ANALYSIS SYSTEM 12:05 THURSDAY, APRIL 20, 1978 41

GENERAL LINEAR MODELS PROCEDURE

PLANS

HEIGHT	SOIL	N	DDFN
3	CL	12	81.33462
3	SA	12	86.100000
3	SI	12	98.488889
6	CL	16	140.000000
6	SA	16	88.750000
6	SI	16	67.692408
9	CL	11	178.181818
9	SA	15	130.666667
9	SI	12	146.666667
12	CL	12	123.333333
12	SA	13	166.151846
12	SI	9	191.111111
24	CL	2	190.000000
24	SA	2	160.000000
24	SI	2	160.000000
36	CL	2	210.000000
36	SA	4	85.000000
36	SI	1	140.000000

HEIGHT	ROW	N	DDFN
3	F	17	121.376671
3	J	16	51.250000
3	O	13	91.641564
6	F	15	92.000000
6	J	11	36.363636
6	O	13	147.692308
9	F	13	186.615385
9	J	17	107.333333
9	O	13	136.625077
12	F	15	130.666667
12	J	8	120.000000
12	O	11	221.181818
24	F	6	150.000000
36	F	1	20.000000
36	O	6	145.666667

HEIGHT	CONT	N	DDFN
3	0	6	136.666667
3	1	40	86.500000
6	0	6	230.000000
6	1	32	20.303030
9	0	6	186.666667
9	1	12	162.500000
12	0	6	363.333333
12	1	28	176.666667
24	0	6	150.000000

STATISTICAL ANALYSIS SYSTEM 12:08 THURSDAY, APRIL 20, 1978 52

GENERAL LINEAR MODELS PROCEDURE

MEANS

HEIGHT	CONT	N	DDEN
55	0	6	146.66667
55	1	1	20.00000
SOIL	MON	N	DDEN
CL	F	21	134.285714
CL	J	11	67.272727
CL	O	18	174.444444
SA	F	22	121.818182
SA	J	19	80.000000
SA	O	24	130.833333
SI	F	18	128.888889
SI	J	17	68.235294
SI	O	20	156.000000



APPENDIX D

MARSH SMOTHERING PLANT INVASION  
2 x 2 FREQUENCY TABLES

Legend for Variable Codes

Inv = Number code of invading species (see Table 25).

Height = Enclosure height

3 = 8 cm

6 = 15 cm

9 = 23 cm

12 = 30 cm

24 = 61 cm

36 = 91 cm

Soil = Dredged Material type

SA = Sand

SI = Sand and Clay

CL = Clay

Mon = Month of Deposition

F = February 1976

J = July 1976

O = November 1976

PART 1

2 x 2 Frequency tables

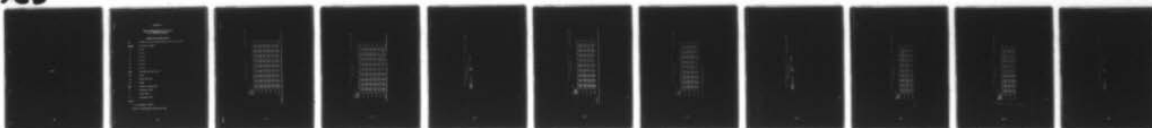
Data of experimental enclosures only.

AD-A063 366

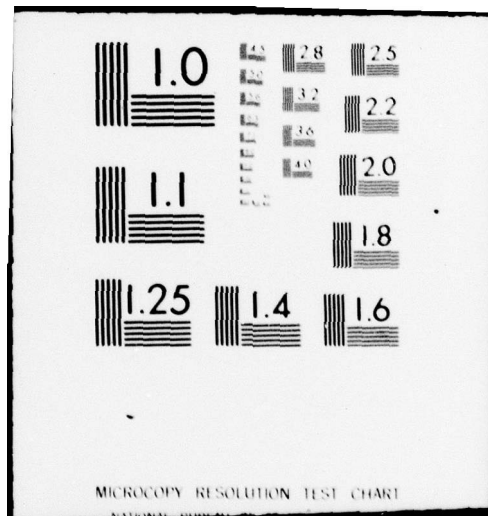
GEORGIA UNIV BRUNSWICK MARINE EXTENSION SERVICE F/G 13/2  
THE EFFECTS OF SMOTHERING A 'SPARTINA ALTERNIFLORA' SALT MARSH --ETC(U)  
JUL 78 R J REIMOLD, M A HARDISKY, P C ADAMS DACW21-75-C-0074  
WFS-TR-D-78-38 NL

UNCLASSIFIED

6 OF 6  
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3-79  
DDC



PART 1

D2

APPENDIX D

MARSH SMOTHERING PLANT INVASION  
2 x 2 FREQUENCY TABLES

Legend for Variable Codes

Inv = Number code of invading species (see Table 25).

Height = Enclosure height

3 = 8 cm

6 = 15 cm

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PART 1

2 x 2 Frequency tables

Data of experimental enclosures only.





STATISTICAL ANALYSIS SYSTEM

TABLE OF HEIGHT BY INV

HEIGHT	INV	29	30	31	32	33	34	35	36	TOTAL
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	289
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.34
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	289
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.34
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	289
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.34
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	289
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.34
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	289
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.34
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	289
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.34
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	289
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.34
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	289
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.34
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	289
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.34
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	289
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.34
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	289
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.34
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	289
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.34
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	289
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.34
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	289
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.34
29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	289
30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.34
31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	289
32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.34
33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	289
34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.34
35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	289
36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.34
TOTAL		0.00	0.11	0.16	0.21	0.25	0.23	0.17	0.23	10.34

8

STATISTICAL ANALYSIS SYSTEM

1150 THURSDAY, DECEMBER 22, 1977

8

STATISTICS FOR P-HAT TABLES

CHI-SQUARE 364.939 D.F. 45 PROB=0.0001

PHI COEFFICIENT 0.448

PHI SQUARED 0.200

PHI SQUARED 0.200

## STATISTICAL ANALYSIS SYSTEM

TABLE JF SOIL BY INV

[illegible]



TABLE OF SOIL BY INH

TOTAL FREQUENCY CELLS IN ROW	INH														TOTAL
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	
1	0.13	0.16	0.17	0.11	0.11	0.17	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	507
2	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	31.75
3	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	1
4	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	1.36
5	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	543
6	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	37.06
7	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	548
8	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	31.75
9	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	1.00
TOTAL	3.06	3.11	3.16	3.11	3.11	3.16	3.11	3.11	3.11	3.11	3.11	3.11	3.11	3.11	101.06



7150 THURSDAY, DECEMBER 22, 1977

STATISTICAL ANALYSIS SYSTEM  
STATISTICS FOR 2-WAY TABLES

CHI-SQUARE	178.042	DF=	51	PROB=0.0001
LIKELIHOOD	0.981			
CONTINGENCY COEFFICIENT	0.833			
CRAMER'S V	0.184			

7550 THOMASVILLE, GEORGIA 22, 1977

STATISTICAL ANALYSIS SYSTEM

TABLE OF 4071 SV INW

FREQUENCY	N	ALL										TOTAL
		1	2	3	4	5	6	7	8	9	10	
1	563	21	0.4	0	0.1	0	0.1	0.1	0.1	0.1	0.1	0.7
2	31.8	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.10
3	81.5	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	82.69
4	30.7	38.43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	69.1
5	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2
6	38.3	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39.8
7	38.8	48.22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	87.04
8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
9	22.2	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.9
10	78.1	77.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	155.4
TOTAL	1000	1000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0

12/28/77 (10)

## STATISTICAL ANALYSIS

ANS: A 5.00m SL 27671

[illegible]

